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THE MOUNT EVEREST EXPEDITION, 1933: *A paper read at Afternoon and Evening Meetings of the Society on 6 November 1933 and repeated on the evening of 8 November 1933, by*

HUGH RUTTLEDGE

EIGHT years had elapsed since the last expedition to Mount Everest when the good offices of the Government of India and of Colonel J. L. R. Weir, Political Officer in Sikkim, secured at last the permission of the Tibetan Government for another attempt. The news was received in August 1932, and this gave but little time for preparation in England, if the new expedition was to start early in 1933.

The Mount Everest Committee, consisting of representatives of the Royal Geographical Society and the Alpine Club, under the chairmanship of Admiral Sir William Goodenough, met without delay. Its first task was to select a leader. Unfortunately General Bruce was no longer available in an active capacity, though he was a member of the Committee; and neither Brigadier E. F. Norton nor Major Geoffrey Bruce was able to accept an invitation to lead. It was necessary to find some one with experience of Himalayan peoples as well as with mountaineering knowledge, and eventually the lot fell upon me. I had served for nearly five years in the Himalayan district of Almora, in the Kumaun Himalaya, and had climbed a good deal with Gurkhas and Sherpas. The advice of members of previous expeditions was freely placed at my disposal, and I was given practically *carte blanche* in the selection of the climbing party and of equipment and stores. The party finally selected consisted of: Hugh Ruttledge (Leader), E. O. Shebbeare, Colin G. Crawford, F. S. Smythe, Captain E. StJ. Birnie, Lieut.-Colonel Hugh Boustead, T. A. Brocklebank, Doctor C. R. Greene, P. Wyn Harris, J. L. Longland, Doctor W. McLean, E. E. Shipton, L. R. Wager, G. Wood-Johnson. Of these, Crawford had been with the expedition of 1922, and Shebbeare with that of 1924. Four others were members of the party which climbed Kamet in 1931.

Every effort had been made to secure a party of which every member, with the possible exception of the leader and the chief transport officer, should be capable of taking part in the final assaults on the mountain. The numbers

were slightly increased beyond those of previous expeditions in case it should be found advisable to stay on after the break of the monsoon, in which case a strong reserve would be necessary. The medical examinations were conducted by the R.A.F. Central Medical Board and by Doctor Claude Wilson, and were of great severity. It was realized of course that the tests applied to pilots of the R.A.F. who are carried to high altitudes without exertion and without preliminary acclimatization, and who use oxygen in liberal quantities, could not afford adequate data for determining the qualifications necessary to take a man high on Mount Everest, but it was at least possible to make sure that his heart and lungs were thoroughly sound, that he had powers of resistance to oxygen lack, and that he would be likely to be able to withstand the great strains imposed by such an expedition.

Not many innovations were made in equipment and stores. The principal was perhaps a new kind of tent combining the properties of an Asiatic *yurt* and of the arctic tent used by the late Mr. Watkins in Greenland. This was of octagonal shape and double skinned. It proved of the greatest value in bad weather conditions. Three such tents were taken.

The oxygen question was still open, and we could not afford to dispense with anything which might contribute to success. The apparatus taken by former expeditions had been heavy and cumbrous. Doctor Greene set to work with his fellow members of the British Committee for Oxygen Supply, and produced an improved and simplified apparatus, admirably made by Messrs. Siebe, Gorman & Co. It weighed only $12\frac{3}{4}$ lb.

Experience has shown that parties going to high altitudes suffer from considerable loss of appetite, and have, in fact, to make a duty of eating. It was therefore necessary to devise a high-altitude ration which should include the correct quantity of vitamins and calories. Doctor Zilva of the Lister Institute very kindly came to our help in the matter. In the event, our calculations were somewhat upset by the fact that slow acclimatization enabled the climbers to assimilate the ordinary foods of civilization up to and even beyond a height of 23,000 feet; and we were obliged to draw upon stores intended for the march and for the lower camps. To eliminate the risk of scurvy in a country like Tibet, where fresh vegetables, fruit, and fresh meat are difficult to obtain, we had recourse to a highly concentrated form of lemon juice.

The main body of the expedition left England on 20 January 1933, by which time various climbing plans had been collated, improved upon by Longland, and discussed in detail by all available members. They provided for no less than four assaults on the summit in the course of one week, but could be indefinitely extended in accordance with the vagaries of the weather.

The keynote of this year's strategy was a slow and methodical advance. No two men acclimatize at exactly the same rate, and it was intended to make our speed, so far as possible, that of the slowest member. The expedition moved out of Darjeeling in two parties with a week's interval; the last leaving on March 12. This was thirteen days ahead of our predecessors. We had been fortunate in recruiting about seventy men of the best type of Sherpa and Bhutia porters, several of whom had previous experience. Among them was Lhakpa Chedi, the best of the "tigers" of 1924.

Phot. H. R.

Slopes of the North Col from Camp IIIa, showing track of ascent (continued by pecked line)

Phot. E. E. S.

Climbing the ice slope below the great crevasse on the North Col

Phot. F. S. S.

Camp IV

We had hoped to proceed to Kampa Dzong by the Lachen Valley and over the Sebu La, which is, in good conditions, much the best and shortest way. Unfortunately the Sebu La was closed to traffic early in March by a sudden heavy fall of snow, so we were obliged to proceed *via* Gangtok and the Natu La, over into the Chumbi Valley and on to Phari. The two parties reunited at Gautsa, where a little preliminary acclimatization was secured at a height of over 12,000 feet.

The Phari authorities have sometimes given a good deal of trouble in the matter of transport. We were spared this by having secured the services of Pangda Tshang, the Tibetan Government trader, who undertook to move our thirty odd tons of equipment and stores right through from Kalimpong to Kampa Dzong.

The Tibetan plateau can be terribly bleak and cold in the early spring. At Shabra Shubra, under the shadow of the great peak Chomolhari, we had 36° F. of frost, followed by a long march through a blizzard which took considerable toll of the party, though no one actually fell out. After this rough introduction, the crossing of the high Donka La and Chago La was unexpectedly easy; after which no serious inconvenience was encountered anywhere except from the strong westerly winds and the dust which blew into our food and into our eyes and throats, causing some trouble from laryngitis and pharyngitis. The porters suffered as much as we in this respect.

On the march from Tatsang to Kampa Dzong we took the opportunity of climbing a hill about 18,000 feet high, both for the purpose of testing our condition and obtaining a view. It was a perfect day. We climbed slowly without distress, and at the summit were rewarded by the most glorious panorama which most of us have ever seen. To the south were the great Sikkim peaks which Doctor Kellas climbed: Pau Hunri, Kangchenjau, and Chomiomo; to the south-west, Kangchenjunga, with the Bavarians' ridge in full view; Jongsong and innumerable unnamed peaks. Nearly 100 miles away to the west was a great triangular snow peak which could only be Mount Everest. The snow had that yellow look which only distance can give.

We descended to the pass on which Kellas died in 1921 and continued down a long narrow valley at the end of which, with tremendous suddenness, appeared the soaring battlements of Kampa Dzong. Here our sirdar Nursang was awaiting us with the advance baggage, guarded by a one-eyed Tibetan mastiff to which he had given the extraordinary name of Policie. This dog faithfully carried out her charge. She was apt to resent a sudden and informal approach, but soon got to know, with unerring accuracy, the members of the expedition, and confined her attacks to her own countrymen, of whom she spared neither sex nor age.

Our passport, and the innate friendliness of the people, smoothed over all transport difficulties; no simple matter when it is understood that transport has to be changed at the headquarters of each successive Tibetan district; no less than four such changes had to be made on the 350-mile march to Mount Everest.

At Tinkye Dzong, the Dzongpen was a native of Lhasa, very sociable and extremely bored by his relegation to an outlying district. He welcomed us with open arms. We organized a sports meeting. The football, begun by the

porters, was soon joined in by the entire Tibetan population, and the ball was soon lost to sight as the multitude surged madly across the ground to the grievous detriment of tent ropes. Boustead gave some boxing lessons which were heartily taken up by some Tibetan children, whom it was impossible to separate once they had joined battle. Then Longland gave an exhibition of pole jumping, which was a great success. All this was followed by a banquet at the Dzongpen's house, where his wife, with her wonderful hoop-like head-dress and a black patch on her nose, did the honours with great dignity.

It is one thing to secure an adequate number of transport animals but quite another to get them laden in good time at the beginning of a march. The drivers all struggle to secure the lightest loads and pandemonium rages. The Dzongpen took an active part in the conflict and got us off in fairly good time for the long march over the Bahman Dopte pass. This northerly route was adopted partly because the inhabitants of Gyanka Nampa to the south had an unenviable reputation as thieves.

We got something of a fright at Dochen, where our postal agent, Lobsang Tsering, had a fall from his horse and broke his collar-bone. The administration of anaesthetics at an altitude of over 14,000 feet is evidently a risky business. Lobsang Tsering did not come round for some time, and Greene and McLean had to work very hard on him before he came to life again.

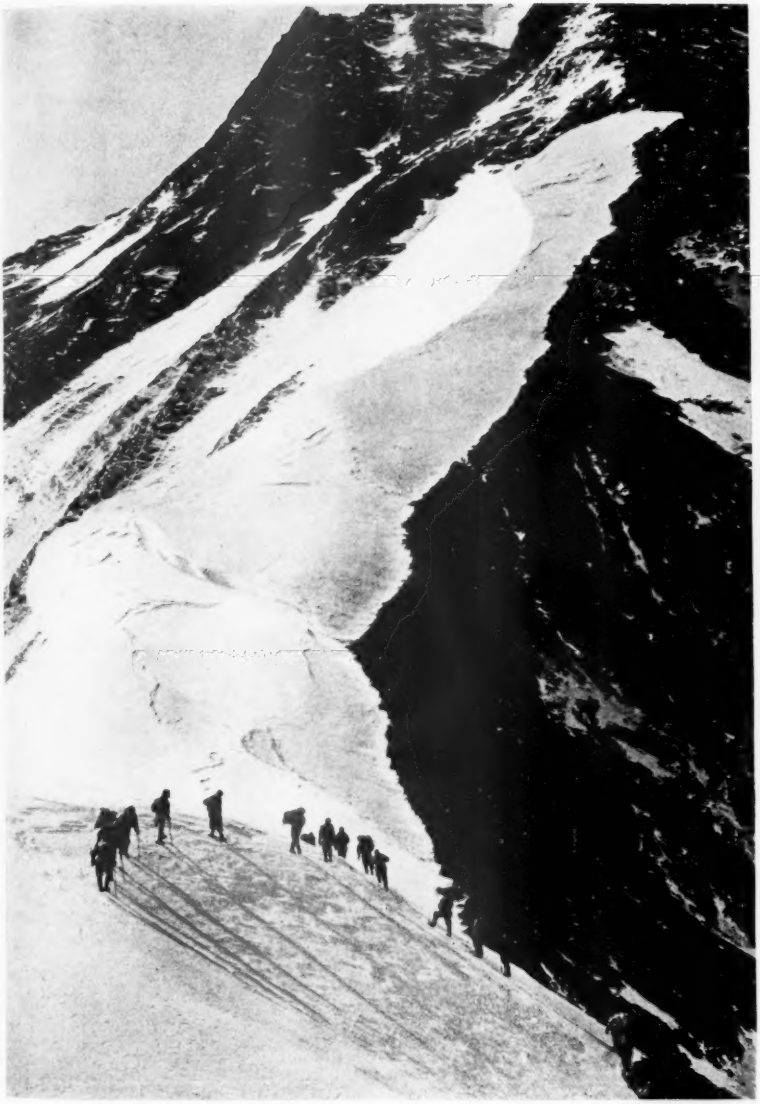
At Shekar Dzong we made the unpleasant discovery that a good deal of our equipment had been pilfered during the march. Grave suspicion attached to the transport drivers whom we had taken on at Dochen. The Shekar Dzongpen, always anxious to oblige, flogged several of them according to Tibetan (and our own mediaeval) practice, but no confessions resulted and nothing was ever recovered.

We climbed the "hill of shining glass," which is what Shekar means, because it was known that Mount Everest, 50 miles away, can be well seen from there in fine weather. With the telescope we could see something of the northern arête, but not enough to judge it in any detail, for there was much cloud about.

From Shekar Dzong, one of the senior porters was despatched over the Khombu La to make some direct recruitment at Sola Khombu, the home of the Sherpas. He was held up by heavy snow and we did not see him again till operations were well forward on the mountain. But when he did come he brought forty-six of the finest porters I have ever seen, among them the famous Narbu Yishé, the *purana miles* (Urdu-Latin for old soldier) of 1924.

We were now marching southwards direct for Mount Everest. The weather was somewhat unsettled: we found heavy winds and a good deal of snow in crossing the Pang La, and got no view of the mountain before dropping down into the valley of the Dzakar Chu. One march short of Rongbuk, at Chödzong, some of us climbed the hill behind the camp in the evening and were lucky enough to get a magnificent view of the north face less than 20 miles away. From this distance it was seen in true perspective, and we realized how much steeper the north-east arête is than it seems to be when viewed from Rongbuk.

On April 16, after marching for hours up a stony and desolate valley which appeared to lead nowhere, we suddenly turned a corner and found the great Rongbuk Monastery outlined against a grim background of wind-torn mists



Phot. H. R.

Looking up the North Ridge from the top of the North Col

Phot. H. R.

Changtse from the crest of the North Col

Phot. F. S. S.

Pumori from the North Col

behind which, we knew, was Mount Everest. A bitter wind was blowing off the mountain, and we lost no time in pitching camp. Fortunately for us the head Lama had recently come out of retreat and was willing, as on previous occasions, to bless the expedition. He did so next morning with full ceremony, to the infinite satisfaction of the porters.

The expedition had reached this point in good health save for sore throats, but the bitter cold of the Rongbuk valley soon led to complications. Wyn Harris developed influenza, and Crawford chest trouble. On the morning of April 17 we covered the 4 miles of rough going to Base Camp at 16,800 feet and put the invalids to bed. We were twelve days ahead of our predecessors. Shortly afterwards one of our strongest porters, Ondi, went down with double pneumonia, and to save his life he was packed off under Crawford's care to the Kharta valley, five marches away.

Our plan this year provided for a slow advance up the East Rongbuk glacier. It was laid down that each successive camp should be thoroughly stocked and held for at least four days previous to a further advance. Camp I was duly established on April 21. A considerable amount of snow about this time hindered progress, but there were nine members of the expedition at Camp II by April 26, where a temperature of 50° F. of frost was experienced at night.

The glacier above Camp II is somewhat intricate, and no time was lost in climbing up the mountain behind it from which the best route could be observed. It would be almost impossible to force a way upwards through the séracs but for the existence of two troughs which descend from the upper reaches of the glacier. The problem is to find a way into the left-hand trough, then out of it on to the open glacier, and down into the medial trough. A way was soon found by Smythe, Boustead, and Wood-Johnson, and red flags were placed to indicate the position of dangerous crevasses. After this the porters could always be allowed to move up without escort.

Wind and snow turned back no less than three reconnaissances towards Camp III, but this was eventually established on May 2. The advance party experienced blizzards similar to that which drove out the party of 1924, but the arctic tents were so efficient that in this case no retreat was necessary, and by May 6 twelve members of the expedition were in full occupation.

We had felt considerable anxiety as to changes that might have taken place in the condition of the North Col slopes. It was soon evident that the 1924 route was out of commission. There was now a tremendous ice slope which would have taken weeks to cut up, and at its foot was the debris of many ice avalanches. The only practicable route was that adopted in 1922; this would require considerable care in view of the fatal avalanche which occurred there in 1922, when seven porters were overwhelmed and killed.

It was arranged that parties should work on the wall in shifts, each man cutting steps for about twenty minutes at a time, while his companions drove in pitons and fixed ropes for the safeguarding of porters. To save time and energy a subsidiary Camp IIIa was pitched close to the foot of the wall just out of reach of possible avalanches. The brunt of the work fell upon Shipton, Smythe, Wyn Harris, Wager, Greene, and Boustead. Bad weather persisted throughout this period, with the result that it took from May 6 to May 15 to

Pumori from the North Col

Changtse from the crest of the North Col

make the route up to the North Col. The general angle of the slopes was very steep, and at one point Smythe had to cut steps up a vertical ice wall some 40 feet high. The old ledge near the crest of the col which was used by the 1922 and 1924 expeditions was no longer in existence, but a ledge was found, in reality the lower lip of a crevasse, about 250 feet below the crest, and Camp IV was established here on the morning of May 15.

Meanwhile two causes for anxiety had appeared. Firstly, Wood-Johnson developed a gastric ulcer which necessitated his descent to the Base Camp. He had shown great strength and staying power, and his loss was severely felt. Secondly, news was received by wireless from Calcutta that the monsoon had appeared off the east coast of Ceylon on May 12. It was evident therefore that no time must be lost.

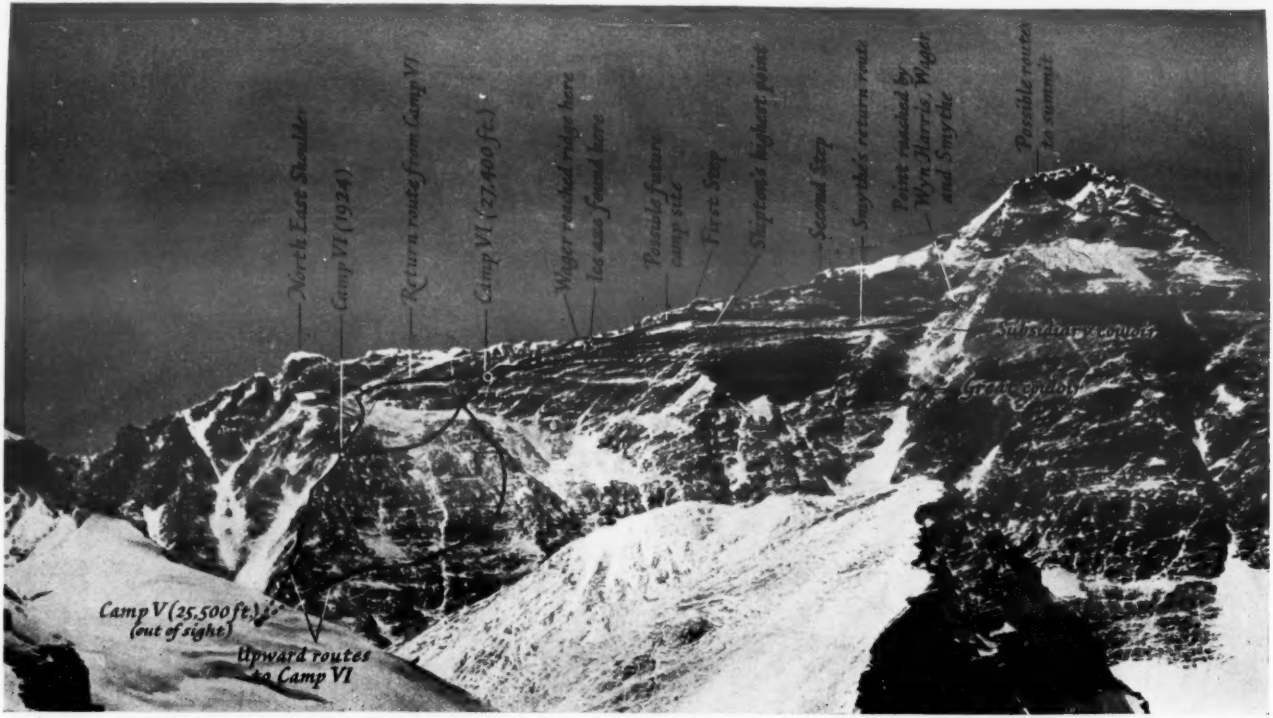
According to our tactical plan, the leading party would not spend more than five days at Camp IV lest deterioration should set in. During temporary lulls in the storms, three attempts were made to reach the site of Camp V, but all were abortive. Finally however a splendid carry was made on May 22. Wyn Harris, Greene, Birnie, and Boustead with twenty-one porters were to establish Camp V, and Wyn Harris and Greene would go on next day to establish Camp VI. Longland and Wager accompanied them for training purposes. Owing to the distance of Camp IV below the crest, this involved a long day's work with an ascent of 2,900 feet. Only one porter broke down, and he was escorted down to Camp IV by Longland. Greene, who had had insufficient acclimatization on the North Col, unfortunately strained his heart on this day, though he insisted on going as far as Camp V. On the way he found one of Captain Finch's oxygen cylinders, which was in perfect working order.

This new Camp V was at 25,700 feet, 500 feet higher than it had been placed before. It was on a fairly good platform which accommodated four Meade tents, but being on the north ridge it is very much exposed to wind. All the porters except eight were at once sent down with Greene to the North Col.

It was vitally important to get on to Camp VI next day, but another spell of bad weather set in and the high party was marooned at Camp V till the morning of the 25th, when it had to retreat, in the course of which several porters were attacked by frostbite. A party going up from the North Col in support met them halfway down the ridge, and the two parties returned together.

Misfortunes never come singly. There had been a heavy fall of snow, which rapidly made the continued occupation of Camp IV impossible, as avalanches started to slip down on to the ledge, threatening to overwhelm the tents. In order to keep up a position of attack, six climbers now took a camp (IVa) up on to the very crest of the North Col itself; an exposed position but safe from avalanches. With them went a newly picked lot of porters who occupied one of the arctic tents. There was no difficulty in procuring volunteers for this service. The rest of us, knowing that there would not be sufficient room at the new camp, descended to Camp III.

Camp V was reached again on May 28 by Wyn Harris, Wager, Longland, and Birnie, and on the 29th the first three, with eight porters, managed to


North East Shoulder
Camp VI (1924)
Return route from Camp VI
Camp VI (27,400 ft.)
Wager reached ridge here
Ice axe found here
Possible future camp site
First Step
Shipton's highest point
Second Step
Smythe's return route
Point reached by Wyn Harris, Wager and Smythe
Possible routes to summit
Camp V (25,500 ft.) (out of sight)
Upward routes to Camp VI

Telephotograph by Capt. Noel of the North Face from the 1924 Base Camp, showing 1933 climbing routes

Phot. F. S. S.

Cho Uyo and Gyachung Kang from Camp V

Phot. F. S. S.

Changtse from Camp V

place our sixth camp at a spot about halfway up the great "yellow band," 600 feet higher and more to the west than the Camp VI of 1924. The effort reflects the very greatest credit, not only on the porters, but on the men who led them, none of whom were fully conversant with their language.

Shortly after the single tent had been pitched one of this year's many blizzards rushed up from the west almost without warning, and in a few seconds it was impossible to see more than a few yards ahead, and all the goggles were iced up. Longland had the responsible task of bringing porters down and carried it out with perfect judgment in the very worst of conditions, verifying his direction by reaching the top of the north ridge and finding, a little lower down, the old Camp VI of 1924.

Next day Wyn Harris and Wager made the first assault on the summit. They had spent a bad night and the air was very cold, although the wind was not blowing at more than 10 miles an hour. They suffered a good deal before the sun's rays warmed things up a little. After about two hours' climbing, and at a point about 200 yards east of the first step and 60 feet below the crest of the north-east arête, they found lying upon gently inclined but smooth slabs an ice-axe. It looked perfectly new, the axe-head of bright polished steel. This axe can only have belonged to Mallory or Irvine, and we think it likely that it marks the site of a fatal accident in 1924, whether during the party's ascent or descent. We think that on the whole the former is the more probable, but it is only fair to state that Mr. N. E. Odell adheres to his conviction that he saw the two climbers both below and on the second step on the day when he followed them up in support. Curiously enough, Smythe and Shipton, while themselves following up in support of Wyn Harris and Wager, thought they saw the latter two on the second step, but satisfied themselves that rocks, over which clouds were racing, had given the illusion of human movement.

Wyn Harris and Wager were much embarrassed by having a dual objective: a reconnaissance of the second step combined with an attempt to reach the summit either by that route or by Norton and Somervell's route of 1924. In consequence, they lost much time in the neighbourhood of the second step, found it was impossible, and were forced to follow Norton and Somervell's route, traversing across the north face 200 or 300 feet below the crest. They crossed the great snow couloir and reached a point on its western wall approximately the same as that attained by Brigadier Norton. The height of this point is about 28,100 feet, and they were there at 12.30 p.m. in the day, having started at 5.40 a.m. Clearly there was no chance of reaching the summit, which would have required at least another four hours for its ascent, and of returning in safety. They might have gone on some little way up the very difficult rocks, for they were not completely exhausted; but had they done so it is doubtful if they would have reached camp again. They were perfectly right to turn when they did, and their work on this day was beyond praise.

On the way back they attempted once more to tackle the second step, but were too exhausted for further climbing. Wyn Harris retrieved the ice-axe, leaving his own in its place, and Wager struggled up a few feet to the crest, and is thus the only man who has looked down the great ice-fluted south-east

Phot. F. S. S.
Changtse from Camp V

Phot. F. S. S.
Cho Uyo and Gyachung Kang from Camp V

wall of Mount Everest. They reported their adventures to Smythe and Shipton at Camp VI, and managed to reach Camp V that evening.

Next day Smythe and Shipton were storm-bound in their little tent, snow falling to a depth of several inches and wind making it impossible to go out; but on June 1 things looked a little better, and although there was too much snow on the slabs to give any real hope of success they set forth. Shipton had neither eaten nor slept well at the high camp, and somewhere below the first step he realized that he must give up, following the rule that no man should go on till he was too exhausted to return unaided. Finding that Shipton was able to get back by himself Smythe quite rightly went on alone, and reached the same point as Wyn Harris and Wager, at 10 a.m. This left him ample time to reach the summit, but unfortunately the snow of yesterday had made the slabs at this point completely unclimbable; and Smythe had the mortification of having to turn when he was going quite well with success almost within view. To explain these conditions it is necessary to observe that snow hardly melts at all above 25,000 feet; and that at 28,000 feet it is of the consistency of castor sugar, affording no sort of support to the feet except in one or two places, where wind pressure has been able to harden it. As the slabs dip outward and downward the danger and difficulty of crossing them when snow lies upon them may be imagined.

Smythe returned by a slightly lower traverse, saw Shipton off on his way to Camp V, and then spent his third night, this time alone, at Camp VI. He slept for thirteen hours at a stretch, heedless of a gale which was blowing, and next day found his way down the whole way alone to the North Col. Shipton had spent the night at Camp V after a narrow escape from a blizzard. A similar storm assaulted Smythe on his descent, and he was several times blown off his feet. It is interesting to note that neither man suffered from any heart trouble as a result of their terrific experiences, though they did have slight frostbite. Wyn Harris and Wager, on the other hand, both suffered from temporarily dilated hearts.

There was nothing for it now but to take the whole party down to Base Camp for a rest. We hoped that possibly a break might occur in the monsoon which would enable another assault to be made soon. Greene examined everybody with great care at Base Camp, and passed nine men in all as fit for further service. A return up the glacier was begun on June 11, and Crawford and Brocklebank went on ahead to examine the North Col slopes. They found the fixed ropes buried 2 feet under snow and the slopes in such condition that any interference with them would inevitably have caused a big avalanche. We stayed for over a week at Camp III, watching Mount Everest get steadily whiter and whiter, and coming reluctantly to the conclusion that after the first big snowfall of the monsoon the mountain remains snow-covered till the autumn, when the west wind of Tibet comes to life again. That west wind is the only agent which will remove snow from the north face. We visited the Rapiu La and climbed the unnamed peak above it, obtaining wonderful views of the south-east face and south ridge of Mount Everest, and confirmed thereby our opinion above stated.

After this we returned once more to Base Camp and reported matters to the Mount Everest Committee, adding that various members were prepared

to stay on at the Base Camp and observe weather conditions for another month or two, and that the few remaining fit men had volunteered to make another assault should opportunity offer. The Mount Everest Committee however, after full consideration of the facts, very wisely recalled the expedition, and we left the Base Camp on the return march on July 2.

The majority were able to travel *via* the delightful Kharta valley, but the invalids, of whom there were three, had to be taken by the less attractive route of the Dzakar Chu. Shipton and Wager forced their way directly over the Himalayan range from Gyanka Nampa to Lachen, while Crawford and Brocklebank crossed the Choten Nyima La.

A short summary of what was learned from this year's expedition may be of some service:

1. The policy of slow acclimatization appears on the whole to have worked well. But the need for striking the balance between it and the parallel process of deterioration should never be lost sight of. Our plan was to establish the higher camps and go for the summit after not more than five days at Camp IV. In the event, bad weather interfered with every plan and upset every calculation.

2. I think it has been established beyond reasonable doubt that the second step is so severe an obstacle that it is a waste of time to attempt it any further, and that therefore the only reasonable route to the summit is that taken for the first time by Brigadier Norton. This route is definitely impossible unless the slabs are found dry and comparatively free of snow.

3. One result of slow acclimatization is the continued capacity to eat more or less normal food at considerable altitudes. A special high-altitude ration is hardly necessary for acclimatized men up to Camp V.

4. The selection of the best type of party will always be extremely difficult, for every man acclimatizes at a different rate and reacts in a different manner to altitude. One thing is certain: mere records of climbs done with guides are of little value in determining whether a man is capable of doing a full share of work on an expedition of this kind.

5. Still further improvements are possible in equipment, notably in the matter of material for tents and the substitution of sleeve openings for canvas doors. The arctic tents of this year were a great success, but might be improved still further.

6. The provision of wireless apparatus was of definite value. This might be extended in future to the use of very light receiving or even transmitting sets for use at the highest camps.

7. That Mount Everest will be climbed some day I have very little doubt; but it will need the coincidence of at least two things: firstly, not less than three days' consecutive fine weather; and secondly, the simultaneous reaching of the top of their form by not less than four men, and preferably six.

DISCUSSION

Before the paper the PRESIDENT (Major-General Sir PERCY COX) said: Before I turn to my duties as President this afternoon I should like to say how tremendously fortunate I feel that the first occasion on which I have the honour

of occupying this Chair should be one of such enormous interest. This will certainly be a red-letter day in my life.

Before introducing the lecturer, in case any of you would like to have your memories refreshed, I will briefly mention what has taken place in regard to the several expeditions for what I may call the "Assault on Mount Everest." For the last forty years the ambition to climb that mountain has been in the minds of Englishmen, whether serving in India or alpinists and mountaineers at home. In particular, General Bruce and Sir Francis Younghusband have probably had it in mind for quite that time. It was, of course, very difficult to arrange an expedition, quite apart from the question of climbing, as there were countries to negotiate with who were not always easy to deal with, and there was also the question of finance. But in 1920, after the Great War, interest in Mount Everest revived and a Committee was formed of members of the Alpine Club and of this Society to collect funds and endeavour to promote and organize an assault on the mountain.

In 1921, as a result of the efforts of that Committee, an expedition was sent out under Colonel Howard-Bury. It was not intended that that expedition should attempt to scale the mountain. Their duty was to make a reconnaissance, explore the approaches, and see if they could recommend any particular route. They sent in a most valuable report from which it was evident that the main factor in the problem of climbing Mount Everest was the weather. It is not possible to legislate for the weather or to know for long in advance what it is likely to be, but on one point they were convinced, namely that if the mountain was going to be climbed it could only be done in the early months of the year.

The next year another expedition was sent, under the command of General Bruce, to attempt the assault. They reached a height of 27,000 feet, that is, within about 1800 feet of the summit. They were beaten by the weather. In 1924 a third expedition went, and Norton and Somervell reached 28,000 feet; Colonel Norton, as he then was, whom I am glad to see present, reaching about 100 feet higher than Somervell on that occasion. Again the weather obliged them to beat a retreat. Unfortunately, when Norton and Somervell returned to camp, Irvine and Mallory decided to make a final attempt before abandoning the task. They had got, perhaps, a few feet higher, though it cannot of course be said for certain, when they were seen by Odell moving above the Second Step. Then the mountain became suddenly enveloped in cloud; the climbers were lost to sight and never seen again; and unless Mr. Ruttledge can tell us anything more, we know no more now than we did then as to their fate.

This year the expedition was entrusted to Mr. Hugh Ruttledge, our lecturer of this afternoon, and it is for me to tell you something about him. He entered the Indian Civil Service in 1909. Prior to that, as a young University graduate spending a holiday in the Alps, he came into touch with Edward Whymper, the great alpinist of Matterhorn fame. From that time Mr. Ruttledge has always been keenly interested in mountaineering. On going out to India in the Civil Service he was for many years stationed in the plains of India, for example at Lucknow, but whenever he came home he went in for mountaineering. In 1926 his duties fortunately took him to Almora, and Kumaon, where he was always in sight of the high Himalayas and among the foothills of the range. While there he naturally had great opportunities for climbing various peaks, and Mrs. Ruttledge accompanied him on many of his expeditions, including a perambulation of Mount Kailas, the sacred mountain famous among Tibetans. He and Mrs. Ruttledge were allowed the privilege of making the pilgrimage, with the result that Mr. Ruttledge is now a "Mahatma." You have heard of the title Mahatma in connection with Mr. Gandhi! The Society is indeed fortunate in

the catholic achievements of its alumni: we have Haji Abdullah Philby among our fellow members, and now Mahatma Ruttledge. But, so far as I know, Mahatma Ruttledge has not become a Buddhist!

Mr. Ruttledge then read the paper printed above, and a discussion followed.

Mr. L. R. WAGER: The last Mount Everest Expedition has been described as non-scientific; in fact, a distinguished member of this Society described it as "resolutely non-scientific." It would be fairer to say that our resolution was directed more to the primary objective, that of reaching the summit of the mountain. Nevertheless, Dr. Greene, as you have heard, made various observations and actually carried out experiments at a height of 25,000 feet, and Mr. Shebbeare, who is an all-round naturalist, was continually adding to his already considerable knowledge of the animals and plants of the country through which we travelled.

One interesting point that seems to have emerged this year is that plants, like animals, have an upward limit beyond which they cannot exist happily. At Camp I, at 19,000 feet, there were about twenty or thirty species of flowering plants belonging to twenty or thirty different genera. None of these existed at Camp II, which was only 1000 feet higher, and even lichens, of which there were three or four species at Camp I, could not be found at Camps II and III. It looks very much as though plants, through lack of oxygen or carbon-dioxide, or moisture, or some such essential, cannot grow above about 20,000 feet.

This year we endeavoured to make more systematic observations of the weather than had been carried out on previous expeditions. Mr. Ruttledge has already explained how very important this matter of the weather is. Mallory gave it as his considered opinion that the chances of any one party reaching the summit of Mount Everest were about fifty to one against, and these odds were largely, in his opinion, due to the very doubtful factor of weather. In the winter the north face of Everest is a dark rock face, because any snow that falls is soon blown away by the violent west winds which blow almost continuously. As the summer approaches a little more snow falls, the winds are less violent and gradually the mountain becomes snowed up. You have just seen photographs which give a good idea of the steepness of the Yellow Band, as we call it, which crosses the north face of the mountain at 28,000 feet. This band consists of overlapping slabs which dip north at 30° but which, like the tiles of a roof, give a face whose general slope is 40°–50°. A mere sprinkling of snow on these slabs covers up the small cracks and roughnesses of the surface which the climber has to rely on for foothold. The snow falls as very fine single-crystal powder, not in flakes, and of course gives no support to one's feet. Therefore it seems that the mountain must be climbed before any snow has fallen, or at any rate while the winds are sufficiently violent to blow away any snow that does fall.

The objection to climbing earlier in the year is the powerful and cold wind. It is rather strange that high up on the mountain the more exercise the climber takes the colder he becomes. That is because the least little bit of exercise causes violent panting, and since the air that the climber is breathing is at a fairly low temperature, there is a general cooling down from somewhere in the lung regions. This is rather a strange feeling which I remember Wyn Harris and I got, to some extent, when we left Camp VI early in the morning when the north side of the mountain was still in shadow. We had to stop occasionally in order to reduce the speed of our panting and warm ourselves up.

That then is the difficulty of climbing Mount Everest very early in the year, and the snow is the difficulty which arrives later. Can therefore the meteorologist

in Calcutta be depended upon to give us warning as to when the monsoon which brings the snow is going to occur? This year Dr. Sen, of the Meteorological Office in Calcutta, sent us daily weather reports, and of course being in a mountain region, we did not at first believe those reports at all. Then we began to realize that Dr. Sen's reports were actually forecasting the weather about two days before it actually came. He also told us when the monsoon was likely to occur; but that seemed so ridiculously early that we could not believe that either. Nevertheless he was right. In future I think we must accept what the meteorologists tell us, and make our arrangements accordingly.

It was an unpleasant surprise this year to find that even by May 30 the mountain had too much snow, although only a sprinkling, to allow it to be climbed, and one wonders what unpleasant surprise the next Mount Everest Expedition will have. But we must at least prepare against the difficulties we know. This is only a tentative suggestion, but I think the difficulty of the early monsoon should perhaps be prepared against by reaching the Base Camp a fortnight earlier even than this year, and allowing those who acclimatize early to make their attempt in the middle of May, when it is reasonably certain that the slopes will be free from snow. Those who acclimatize slowly would be in reserve to make their attempt if a good spell should occur in early June. Of course there will be violent cold winds in May, and it is not certain whether a climber can stand up to those winds or not. The one thing however which I think is quite certain is that as soon as the upper part of the mountain is sprinkled with half an inch of snow there is no hope of climbing it until the snow is blown away. I think Mallory's estimate of fifty to one as chances against climbing the mountain can be reduced. From our further knowledge of the weather, acclimatization, deterioration, and so on, I should think it would be fair to say the chances of any one party being able to get to the summit are perhaps now only five to one against.

Brigadier E. F. NORTON: On the walls of the Rongbuk Monastery there were in 1924 some crude frescoes, one of which depicted the demons of Mount Everest pushing a white man down off the mountain. I think the Lama who painted that picture was not a bad prophet, for before the departure of this year's expedition, when Mr. Ruttledge and I were discussing the chances, I remember saying, "Only two things can cheat you of the top: the failure of the porters to carry to Camp VI, or the weather." As you have heard to-night, weather, and nothing but weather, did cheat this party of the top—such weather in the month of May as we never anticipated, as we have never experienced before, even in 1924, followed by what was, I believe, the earliest monsoon of a century. I think it clear that the demons of Mount Everest had a hand in it this year!

But if they were cheated of their chance of the top, to this year's expedition can be attributed several achievements which will be a big contribution to ultimate success. First and foremost, I put the fact that they have removed once and for all the fear that the porters would break down and fail to carry Camp VI sufficiently high, a fear which has been the bugbear of everybody connected with this problem ever since Mallory and Geoffrey Bruce had to return for that reason in 1924.

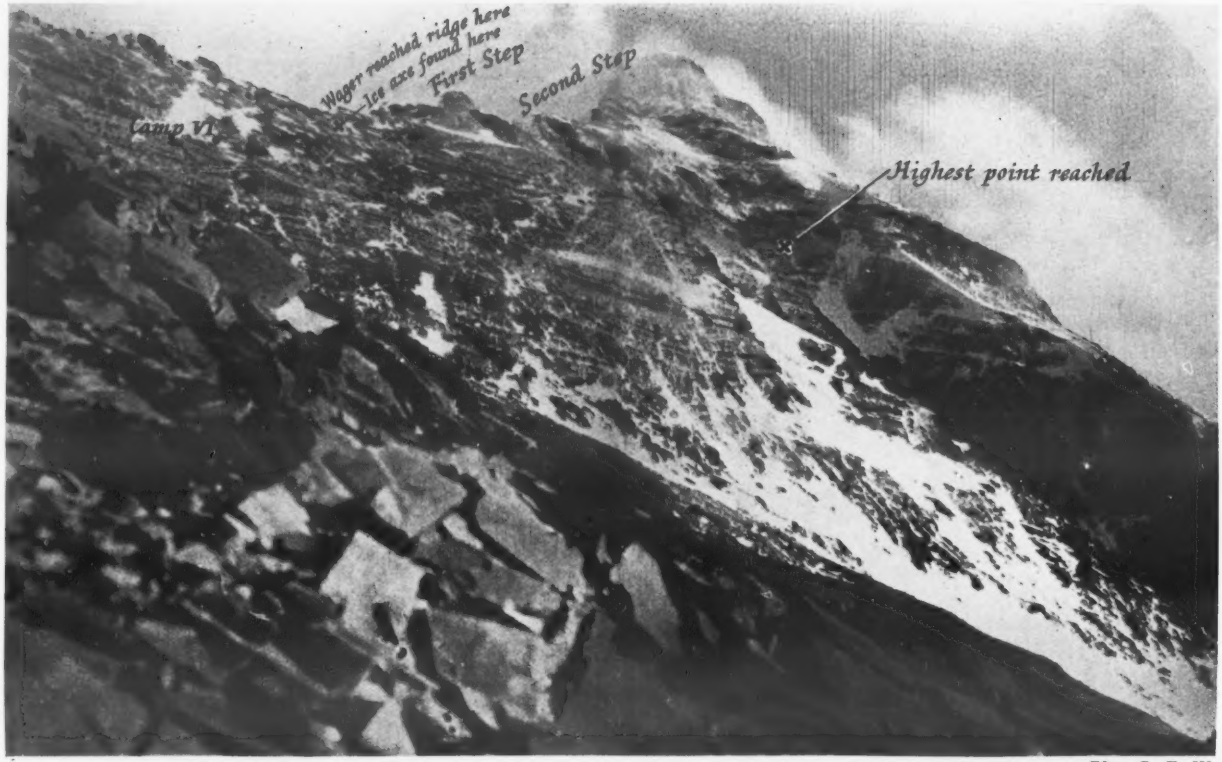
Again, this year's expedition has made it a commonplace for parties to sleep night after night at the higher camps above Camp IV: to sleep not only two nights but a third night at Camp VI at 27,400 feet, and to sleep the clock round! That makes one smile when one looks back and thinks that in 1922 four of us started out from the North Col to see whether it was possible for human beings to exist without oxygen at 25,000 feet, and if they could exist, could they sleep? And particularly when one remembers that one of our leading scientists before the

Phot. F. S. S.

Looking north-east from Camp V

Phot. F. S. S.

Wyn Harris and Wager leaving Camp VI for Camp V on May 30, after the first assault



The North Face from above Camp V, May 29

Phot. L. R. W.

Phot. L. R. W.

The North Face from above Camp V, May 29

departure of the 1924 expedition said to General Bruce, "You may put a party at 27,000 feet, but nobody will ever sleep there without oxygen."

Again, this year's expedition has proved that parties can continuously climb and descend that steep snow and ice wall below Camp IV, after monsoon conditions have set in, with impunity. There again they have removed one of the greatest bugbears of all previous expeditions, although personally I should feel a little happier if I knew the explanation of the immunity this year from a danger which overtook the 1922 expedition the very first time they tried it. I do not think we quite know why. Anyhow, they have proved that the odds are very much more against an avalanche after the monsoon has set in than we ever thought.

No one who has not himself tried to organize an assault on the mountain can realize what these three achievements of the 1933 expedition, coupled with their improvement in equipment and with their contribution to the acclimatization problem, mean as a contribution towards the success of a more fortunate party another year. Make no mistake: success was never on the cards this year. This expedition never had a chance. Mr. Ruttledge, the leader, succeeded in laying out on the mountain what we had regarded before he started as the ideal organization of the camps and the ideal disposition of the climbing parties. To him and to the porters, no less than to those who trained and led the porters, must go the credit for complete success in this department. And when we turn to the climbers, Wager and Wyn Harris did exactly what their job was. They disposed, I think, once for all of any hopes of the ridge route, and they cleared the way for Smythe's and Shipton's attempt. I consider that Smythe's single-handed attempt on that horribly dangerous wall under the conditions it was in at the time represents the legitimate limits of resolution and courage if it does not rather overstep them.

I said this year's expedition had cleared the way for future success, but in one respect I must admit that the prestige of the mountain has gone up and our optimism as to any one party succeeding on any one occasion has proportionately diminished. I am talking of the actual physical climbing difficulties. There is a tendency now, I think, to regard that wall, on which three successive parties have now been brought to a halt, with more respect than before. I have been fortunate in encountering that wall under better conditions than the others, and I personally have no doubt that it is negotiable, given rock completely clear of snow. With any depth of snow on it—and here I am only repeating what I said when I came back in 1924—there is no question that it is absolutely unsurmountable. And I think we can trust the demons of Mount Everest to see that we are very unlikely to find the rock completely clear of snow.

In conclusion, I should like to congratulate the speaker this afternoon on a very fine story told with all that modesty which has been so characteristic of the conduct of the whole of this year's expedition.

Mr. T. A. BROCKLEBANK: I am afraid I have not much to contribute to the discussion as I am not a man of science, but I hope I cannot be accused of being in any way "resolutely non-scientific." Brigadier-General Norton raised the question of the condition of the snow this year on the North Col slopes. I can only say that most of the time when it was open to traffic after the first difficulty of reaching the North Col had been surmounted there was, after a time, a good hard track most of the way up from which we hardly varied our route. That probably made the passage from Camp III to Camp IV a great deal safer than it would otherwise have been. On the other hand, the second time we went up the glacier on May 15 we attempted to reopen that route. By then the monsoon was in full blast, and not only was there a foot or two of new snow covering up

the fixed ropes but underneath that the old snow appeared to have remained, and one could drive an ice-axe in right up to its head, and even then there was no evidence that one had reached anything firm.

Mr. Ruttledge has told us this afternoon a great deal about various members of the party, but remarks about himself have been conspicuously absent. I shall always remember one little scene at Camp III on, I think, May 31, when those of us who were resting there were waiting and waiting for news of Wyn Harris and Wager. We had hoped to hear the previous evening some news of their attempt, and naturally by the next day we were all somewhat anxious. I think the only visible sign of Mr. Ruttledge's anxiety was when he went out of the tent—the whole mountain was covered in cloud—and solemnly trained the telescope on the mountain and looked into a perfectly blank cloud.

The PRESIDENT: You will all agree, I know, that we have had a most extraordinarily interesting lecture. The photographs have given us a vivid idea of what the party went through. Mr. Ruttledge himself, as Brigadier Norton has said, has spoken modestly and said little of his own part in the project, but we can all see from the man and from the story he has told what great qualities of leadership he must have displayed in running the expedition as he did and bringing the party back without casualty of any sort, a fact which does great credit to every member of the expedition and himself. I do not feel qualified to enter into the technical aspects of the ascent, of which we have heard from Brigadier Norton, but I do feel that as long as the summit of Everest remains unconquered there will always be some Englishman ready to undertake an expedition to climb it. For the present, as you will have gathered, the outlook does not appear very promising. I can only express the hope that if the Tibetan authorities relent in a year or so's time, Mr. Ruttledge may be able and fit enough to conduct an expedition again. I am sure we could not possibly have a better leader.

As you have been notified, Mr. Ruttledge has been good enough to agree to give us two lectures, one in the afternoon and one in the evening. Seeing that he is exceedingly busy with his book, this is no small task to impose upon him, but he has readily responded to our appeal for a second lecture in order that as many Members of the Society as possible may have an opportunity of attending the lecture. I will ask you to show in the usual manner your enthusiasm for the admirable lecture which he has given us this afternoon.

At the Evening Meeting the President introduced the lecturer in terms similar to those used in the Afternoon. Mr. Ruttledge then repeated the lecture printed above, and further discussion followed.

Mr. F. S. SMYTHE: After Mr. Ruttledge's most comprehensive account it is very difficult indeed to find anything else to say. The factor that cannot be stressed too strongly is, of course, the time factor. This year the plan of attack, with the exception of acclimatization, was substantially the same as in 1922 and 1924, and attacks were launched from the North Col. With too prolonged acclimatization, deterioration sets in, and when planning an attack this has to be considered. When Shipton and I first went up from the North Col to make a reconnaissance towards Camp V we climbed 1500 feet in about one and a half hours. At the same time, I very much doubt whether we should have been able to have climbed to 28,000 feet. When we went up later we found we could only manage about 600 feet an hour from the North Col to Camp V. But given the same easy ground above Camp VI, I think we could have climbed at 400 to 500 feet an hour; and so what you lose on the roundabouts of deterioration you gain in the swings of acclimatization.

Phot. F. S. S.

Looking north from the east side of the great couloir at about 28,000 feet

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The summit and last section of the north-east ridge; from a photograph taken on the Mount Everest Flight

With regard to attacks on the mountain, they must be launched from a camp as high as possible, and the question arises, is Camp IV on the North Col the best point from which to launch an attack? There are some who think that Camp V would be better. Camp V this year was most frightfully uncomfortable. We had little tents of aero-wing canvas. I am afraid I referred to them as "gossamer" canvas. The snow blew, not only through the entrance, but through the side of the tent and made life very uncomfortable indeed. If one could get up to Camp V a small Arctic tent like the tents we used up to Camp IV but weighing much less than 80 lb., and capable of sleeping four men and enabling them to live as comfortably as possible in it, I think one could spend some days at Camp V and choose the time for the attack. The possibility of getting three days' good weather is far less than the possibility of getting two days' good weather, and the possibility of two days is not half that of one day, but somewhere about one-tenth. If Camp V could be made really comfortable, and the attack launched from it, I think there would be a much greater chance of getting to the top.

As regards the position of the camps, it does not seem that Camp V can be improved upon. For one thing, a longer carry from Camp IV would be almost impossible. This year, with Camp IV at only 22,800 feet, and Camp V at 25,700 feet, it was as long a carry as any porter could possibly be expected to do. Camp VI was pitched well to the east this year with the idea of gaining the crest of the North-east Ridge to the east of the First Step, but we know now that the ridge is not the best route. Therefore the next expedition should endeavour to pitch Camp VI under the First Step.

As regards Brigadier Norton's traverse route, I think it would be much better to go lower along the Yellow Band, which is slightly concave in angle, for when coming back low down from my highest point I found it much easier climbing than going. It is necessary to get into the subsidiary couloir on the other side of the steep buttress, at the foot of which the main couloir and subsidiary couloir bifurcate. This subsidiary couloir is the most dramatic thing on Mount Everest, because it forms the only breach in the band which runs across the northern face of the final pyramid. It is much better to traverse the buttress low down because the upper part of it is steeper than the lower.

One of the difficulties of the final assault, apart from the time factor, will be getting back to Camp VI. The sudden storms which approach with no warning are very disconcerting. The storm which caught Shipton on the way down and the storm which caught me were the most sudden I have experienced on a mountain. They were unheralded by clouds and came out of a blue sky. In five minutes a wind probably over 80 miles an hour was blowing. If the climbing party is caught in such a storm it is not going to get back to Camp VI. There is 300 feet of very steep ground. It would probably be advisable to take some light line and fix it to a piton above the worst section. Then the climber, who is going to be pretty weak and tottery about his legs, may have a chance to get down without disaster.

General BRUCE: I should like to stress one point. I do not think we can be in any way disappointed that the summit was not reached. The expedition did all that men could possibly do. It may be that their performance has been equalled before, possibly on one or two occasions; but even that is doubtful. I really want to make one or two remarks with regard to the porters. I think it is becoming a tradition among Sherpas, and what makes me think so is that many came to join the expedition of their own accord. They came from Solar Khombu to join Mr. Ruttledge without compulsion. They were simply advised that they were wanted and forty-six men came. There could have been no compulsion.

The summit and last section of the north-east ridge; from a photograph taken on the Mount Everest Flight

"The Times" World Copyright

Think of a very primitive people who are taken up to work on the great mountains without anything like the incentive or interest that we have, and who experienced from the first difficulties and dangers, and actually lost, on our 1922 expedition, no less than seven of their people in one accident, and another falling down a crevasse. You would have thought that might have put them off. But in 1924, when I went back I found 250 of them waiting to be chosen. Since then they have taken part in all the expeditions in the Eastern Himalaya, notably Dyhrenfurth's Expedition to Kangchenjunga, and both the Bavarian attempts on the same mountain; and on those expeditions they have suffered further losses and an immense amount of frost-bite. But that seems to egg them on more than ever. When I got up to Darjeeling this year they were absolutely tumbling over each other in their eagerness. The tradition of joining in the great exploration of the mountains has arrived, and I think in future first-class porters will always be forthcoming. I do not know whether there is anything in it, but after the first expedition they all said to me that the accident was the sacrifice claimed by the mountain and that now half the terror of the mountain would go. How far that modifies the case I cannot say, because they have had many accidents since. Still, that was the idea, and not only amongst the porters but amongst ordinary Nepalese. Lhakpa Chedi did not think much of that himself. He and I were old friends, as we had been travelling about Sikkim before these expeditions were thought of. That was about the time that I was told by the doctors that if I walked uphill I should die!

There is one question I should like to ask Mr. Ruttledge. When the expedition was driven off the mountain in 1922, during that winter the Lama at Rongbuk monastery had a beautiful picture painted which I understand was intended to depict the defeat of the 1922 expedition. I think it is probably in the monastery now, and I wonder whether Mr. Ruttledge saw it. It pictured the demons of Mount Everest driving the expedition off the mountain, and little demons spearing the unfortunate leader. I can certainly bear witness to the character of that very remarkable man, the Head Lama of Rongbuk, to bear out what he did this year, and, I think, what he has done for all expeditions; when the morale was low he blessed the porters and re-established their confidence. I do not think I have more to add except to wish "Good luck" to the next expedition to Mount Everest which may or may not go in 1936.

Mr. COLIN G. CRAWFORD: I should rather like to disagree with Mr. Ruttledge on one point. He disclaims any relationship with Mahatma Gandhi, but he certainly adopted Mahatma Gandhi's gospel of non-violence. As regards the expedition this year I should like to draw one or two comparisons between the 1922 expedition, of which I was a member, and the 1933 expedition, and although the points have already been somewhat laboured I would like to draw attention to the difference in weather conditions. I looked up my diary for 1922 and I noted that in my 1922 diary I mentioned the bad days, while in 1933 I mentioned the good days. In a period of one month, May 4 to June 4—this was mostly on the glacier and of course did not affect conditions at greater altitude—I only noted two days of sun and one day of very bad wind. Of course one always had the wind, and one only noted exceptionally powerful winds. In 1933 there were about two or three good days, all the rest being bad days. We had very bad weather in 1922. Still, if the weather in 1933 had been no worse than in 1922, I believe that the mountain would have been climbed.

Both Mr. Ruttledge and General Bruce have mentioned the improved morale of the porters. In 1922 one felt they were subdued by the mountain; there was an undercurrent of apprehension. In this year's expedition one did, of course, have failures, but they were laughed at. One gentleman succeeded in concealing

himself in the cook's tent for three days when he was required to carry; and when he was finally dragged out everybody laughed at him, instead of being rather impressed by the circumstances that must have produced his state of mind. Similarly, when one of the porters broke down on the North Col all the rest of the men just laughed at him. The porters have completely lost, as far as I can judge, their traditional fear of the mountain.

I am under the same disability as Mr. Smythe, who had, apparently, noted points to speak on and found Mr. Ruttledge had dealt with them all before. As to the Arctic tents: our equipment this year was very much more complete than in 1922, and I personally was never cold in an Arctic tent. Actually when one slept five or six in an Arctic tent one was far too hot. Our sleeping-bags were designed for more severe conditions than you could experience in an Arctic tent. In a Whymper or Meade tent I think conditions were none too warm, but in an Arctic tent one began to feel one was in an Indian hot season. I think those Arctic tents made all the difference this year in the successful occupation of the higher camps.

The President expressed the thanks of the Meeting to the lecturer and renewed his congratulations to the leader and all members of the Expedition.

Since a large number of Fellows and their friends were unable to obtain admission to the Evening Meeting on November 6, a third meeting was held on the evening of Wednesday, November 8, when Mr. Ruttledge very kindly repeated the lecture.

THE KERGUELEN ARCHIPELAGO: *A paper read at the Evening Meeting of the Society on 6 March 1933, by*

SIR DOUGLAS MAWSON, O.B.E., F.R.S., D.SC.

A SHORT summary of present knowledge concerning the Kerguelen Archipelago is the object of this paper. Until quite recently information has been only fragmentary. During the past hundred years scientific expeditions have from time to time paid short visits to those shores, and as a result, maps of sections of the coast were, in due course, published. For the rest, the outline was but vaguely indicated on the charts. It was not until the appearance of Rallier du Baty's map[1] of 1922 that there was presented a practically complete plan of the whole of the Archipelago having any claims to accuracy. Even in this however there is little indication of the topographic features of the interior of the land.

Within the last few months Dr. Edgar Aubert de La Rüe has published a memoir on Kerguelen Island which will become a classic.[2] He conducted his field operations in two stages: the first just before and the second just after our visit to the Archipelago in the *Discovery* in the summer of 1929–1930. As most of our activities were concerned in cartography, hydrology, and biology there has been little overlapping, for de La Rüe's objective was primarily a geological reconnaissance with special regard to economic minerals. Our observations did not extend beyond the south-eastern quarter of the group. In that area we have been able to add materially to du Baty's map. Commander M. H. Moyes and the ship's officers, principally the navigating officer, Lieut. C. C. Colbeck, completed the delineation of some of the fjords leading inland from the Gulf of Morbihan, and also more accurately charted certain dangers to navigation. They also obtained numerous soundings in the main channels used by visiting ships. Further very valuable geographical information was obtained by means of aerial photographs secured by Flying Officers S. Campbell and E. Douglas.

A Breton navigator, Captain Yves de Kerguelen, was the discoverer of the Archipelago. He was on a voyage in command of two vessels, *La Fortune* and *Gros Ventre*, sent south by order of the King of France to discover the *Terra Australis Incognita*—the great Southern Continent reputed to exist south of the Indian Ocean. On 12 February 1772 they sighted land. On the 13th one of Kerguelen's lieutenants landed in a bay in the south-south-west of the Archipelago. This inlet he named Baie du Lion Marin, but on the latest French maps it is now designated Anse de Gros-Ventre. Sickness and bad weather caused them to return home without extending their investigations, but fully convinced that they had discovered the famed, though hypothetical, "Southern Continent." The following year Kerguelen went south with a second expedition, comprising three ships, but was disappointed to find on

[1] "La Voyage de la *Curieuse*," par R. Rallier du Baty, *La Géographie*, January 1922.

[2] "Étude Géologique et Géographique de l'Archipel de Kerguelen," par Edgar A. de La Rüe, *Revue de Géographie Physique et de Géologie Dynamique*, Paris 1932. (This work contains a very complete bibliography of literature relating to Kerguelen.)

further exploration that the land which he had discovered and which has since borne his name was but an archipelago of islands. France then for more than one hundred years lost interest in Kerguelen's discovery.

In 1776 Captain Cook, on the way from the Cape of Good Hope to the Pacific on his third voyage, commanding the *Resolution* and *Discovery*, came in sight of the Iles Novageuses on 24 December 1776, and on Christmas Day entered the Baie d'Oiseau, which he named Christmas Harbour. They stayed a few days and made interesting and valuable observations.

From the beginning of the nineteenth century until at least 1870 a considerable oil and fur industry was based in the Archipelago. Sealers and whalers, chiefly American, carried on a hazardous, arduous, but evidently profitable business hunting fur-seals on the beaches and boiling down penguins and sea-elephants for their blubber. Also they hunted the Southern right-whale, at that time plentiful in the adjacent seas. The peak period of this industry was about 1847, when, it is reported, as many as three hundred deep-sea-going vessels were annually employed around those shores. The extinction of the fur-seal and the diminution of the sea-elephant and right-whale to unprofitable numbers speedily reduced the trade after the middle of last century. Then followed the discovery of mineral oil in Pennsylvania and consequent decline in value of animal oils, thus putting an end to the heroic days of Southern whaling and sealing. Among the American whalers to be remembered is Captain R. Rhodes, who about 1802 made sketches of the coast which were subsequently incorporated in the Admiralty Chart.

In the meantime other scientific expeditions had visited those shores. Ross's expedition in the *Erebus* and *Terror*, on the way to what was subsequently charted as the Ross Sea, arrived at Kerguelen on 5 May 1840 and remained until July 29. They charted a considerable length of the north coast and made very valuable scientific observations. The *Challenger* arrived on 7 January 1874 and departed on the 31st of the same month. Again valuable scientific observations were made and charting was effected in the south-eastern portion of the group.

During 1874 and continuing into 1875 vessels of several nationalities made visits in connection with observations of a transit of Venus across the face of the sun. In February of that year the *Arcona* paid a short visit and selected a base for the German expedition which arrived in the *Gazelle* on October 26 and took up quarters at Betsy Cove. A British expedition arrived in the *Volage* on 5 November 1874 and departed in the *Supply* on 21 February 1875. This main base was established at what is known as Observatory Bay. An American expedition established a base at Molloy Point in November 1874 and departed in January 1875. All these parties, in addition to their astronomical observations, advanced knowledge of the natural history of the islands. The Germans also contributed considerably to the cartography of their location.

Towards the end of last century the Kerguelen Archipelago was regarded with increasing interest by European powers. Thus prompted, the French Government dispatched Commandant Lieutard in the *Eure* to take possession in the name of France. The *Eure* arrived on 1 January 1893 and raised her flag at Christmas Harbour at the north-west end of the island and again later

at the Gazelle Basin towards the east end. A concession over the Archipelago for the duration of fifty years was then granted to MM. René and Henri Bossière. Endeavouring to further the economic development of the group these gentlemen created the "Compagnie Générale des Iles Kerguelen," which, together with its offshoots and lessees, has continued ever since to whale and seal in those waters.

The Deutsche Tiefsee Expedition (1898–1899) in the *Valdivia* spent from 25 to 29 December 1898 in the Gazelle Basin, making valuable collections during that short visit. The Deutsche Süd Polar Expedition (1901–1903) in the *Gauss* spent from 1 to 31 January 1902 in the Gulf of Morbihan. Also they established a land station at the old quarters of the British Transit of Venus Expedition on Observatory Bay. This station was continued for more than one year with conspicuous success, though their geographical programme was curtailed owing to the death of the leader of the party. This expedition contributed greatly to knowledge of the island.

Two brothers, MM. H. and R. Rallier du Baty, visited the islands in a 45-ton ketch the *J. B. Charcot* between the dates of 4 March 1908 and 3 June 1909. During this fifteen months they examined in detail the east coast. Again, several years later, Mons. R. Rallier du Baty, accompanied by MM. J. Loranchet and G. Saint-Laune Gramont, set out for Kerguelen in *La Curieuse* equipped with necessary apparatus to effect a hydrographic survey of the coast. They arrived at the end of October 1913 and departed in April 1914, after accomplishing a magnificent piece of work; no less than a chart in considerable detail of the whole main coast-line. The collections brought back also proved of great value to science. During the course of 1922–1923 M. Étienne Peau of the Havre Museum visited the islands, obtaining transport by sealing vessels. His special object was to investigate the natural history, a knowledge of which he materially advanced. There followed important publications in the fauna, flora, and petrology.

In 1924 France issued a decree attaching these islands as well as other possessions in the extreme south of the Indian Ocean, embracing Saint Paul and Amsterdam Islands, the Crozet Archipelago, and Adélie Land, to the Government General of Madagascar.

In 1928 MM. R. and H. Bossière, then at the head of the "Compagnie Concessionnaire des Iles Kerguelen, Saint-Paul et Amsterdam," formed a syndicate to investigate the mining possibilities of Kerguelen. Edgar Aubert de La Rüe was appointed geological expert to the syndicate and voyaged there on board the *Austral* of the "Société des Pêches Australes." He did not succeed in finding any valuable metalliferous, mineral, or guano deposits. Nor were any of the lignite outcrops deemed of economic worth. He has however drawn attention to quite important agate-bearing localities, especially at Port Mary on Foch Island. His first visit extended from 12 November 1928 to 25 February 1929, and was followed by a second expedition in 1931, from January 25 to March 29. During these two periods he had the opportunity of examining the greater part of the coastal region of the island, and in some places carried investigations far inland. But, above all, his contribution has been rendered much more valuable because he has co-ordinated with his own work that of all the many previous scientific workers, and with a very complete

Looking nor.h-west up Bossière Arm

Looking south-east down Laboureur Arm

Looking west across Island Harbour: Mount Ross in distance

bibliography presents in one volume a summary of the geographical and geological information available.

Notwithstanding the foregoing achievements there still remains in Kerguelen a wonderful field for geological and geographical inquiry. Additional facts will shortly be forthcoming when reports upon our own collections are published. For the purpose of this present paper it now remains only to furnish a summary of the broader features of present knowledge with special reference to geography and geology.

Geographical features

The Kerguelen Archipelago in the Southern Indian Ocean is centred on lat. 49° 30′ S. and is equidistant from Australia and Africa. It is just far enough south to fall within a region where navigators may expect to meet icebergs. Also outlying rocks are a feature of the Archipelago. Consequently in this wild and stormy neighbourhood navigation is a matter of some anxiety.

The islands are scattered over a length from north to south of about 124 miles, and west to east 92 miles. The main island has a somewhat triangular shape with greatest dimension about 87 miles and an area in the neighbourhood of 2000 square miles. This area appears small considering the large spread of the land. The apparent anomaly is due to the remarkably indented character of the coast-line. Besides the main island there have been mapped about four hundred smaller ones of which only about a dozen have any considerable size, and many of them are but mere islets. Further, to complete the picture it should be mentioned that protruding from the sea in the coastal waters there are also swarms of rocks not large enough to merit the title of island.

In the compilation of the recent French maps, particularly that accompanying Dr. Aubert de La Rüe's report, many of the names appearing on the old British Charts have been replaced by others, most often French names. This, it is explained, was done after careful consideration with the object of improving and simplifying the nomenclature and with due regard to names appended by the original discoverers of the various features. Foreign names have been translated and some awkward ones employed by the early sealers have been removed.

The land is mountainous and very deeply dissected by ramifying fjords which extend far into the main island, thus constituting a vast series of inland waterways available as harbours for ships. The heads of some of these arms of the sea accessible through Royal Sound are 30 or more miles from the open ocean. But the western coast, which is the weather shore, is much less broken. There harbours are few and bars extend across the mouths of most of them. As that is a lee shore facing constant heavy westerly seas, it is unfavourable for the approach of vessels and consequently little frequented.

The build of the land is, in the main, that of a heavily dissected, elevated plateau, relieved by peaks still more elevated, and finally dominated by the striking mass of Mount Ross, which approximates to 6400 feet in height and is the highest point of the land. These peaks are all volcanic but have long since ceased to be active. The higher portions of the main island, more particularly such as are situated on its western side, from which direction the moisture-laden winds come, are permanently ice-capped. At lower elevations

Looking west across Island Harbour: Mount Ross in distance

snow, which falls copiously during nine months of the year, melts in the short summer season. The strong westerly winds after pouring over the west coast highlands descend upon the eastern region as comparatively dry winds, and serve to clear away the winter mantle of snow. The level of permanent snow varies considerably in different parts of the Archipelago, depending upon geographic position. It is lowest in the west and highest in the drier north-eastern areas. Aubert de La Rüe estimates the average level to be somewhat over 2000 feet, but along much of the steep western coast it descends to about 650 feet.

There are to be observed four notable permanent ice-caps, namely Mount Ross (6400 feet) on the south coast, Mount Henri Rallier (4150 feet) at the south-west corner, Mount Richards (3750 feet) near the north-west of the island, and finally the Cook Calotte. The latter appears on most French maps as the Grand Arête de Glace. It is an ice-cap glacier covering an extended elevated region on the western side and centre of the main island. From it, valley glaciers extend to lower levels, actually reaching the sea and shedding bergs at three points on the west coast. At least six other glaciers on the west and south coasts descend practically to sea-level. The Cook Calotte has a smooth-domed surface unbroken by nunataks. It maintains a summit level of about 1000 metres. Its thickness is unknown, but it appears to stand upon an elevated basaltic plateau. It is rarely visible on account of the prevalence of clouds which, even in good weather, usually hang below the summit. When the clouds rise higher a strong ice-blink can be noted even when the observer is a great distance off. This interesting ice formation has not yet been explored and present knowledge concerning it is but vague.

Geological features

The Kerguelen Archipelago is a monument to igneous forces pent up beneath the great ocean basins. Sediments derived from the igneous outpourings play only a minor part in its structure. The magmas represented tend, in the main, to fall into one or other of two great groups. First is the more widely extended feature in the nature of vast floods of a basaltic character. Then comes the less universally distributed intrusions and extrusions of more acid magmas in which phonolite and trachyte bulk importantly.

De La Rüe's interpretation is that there was an earlier great period of phonolitic and trachytic outpourings, followed later by floods of basalt smothering, for the most part, the former phonolite topography. Our observations suggest that the sequence is not so clear cut, but that alternating and even contemporaneous effusions of basalt and phonolite lavas took place at intervals over a long period of time. Some of the phonolite extrusions are of late age and have been extruded through the basalt.

While the great bulk of the rock exposures are of the nature of surface effusions, there was discovered by Rallier du Baty in the south-west of the island an exposure of a crystalline plutonic character. De La Rüe has investigated and extended this discovery. He has proved that extensive outcrops of the kind occur along the south-east coast of the Rallier du Baty Peninsula. The forms which include monzonite, micaceous diorite, syenite, and some more strongly alkaline, have been ably described by Professor A. Lacroix

Molluscan beds at the Cat's Ears

Air photograph of the crater of Mount Ross, looking south-west

and others. Erratics of these granular rocks have also been found in several localities round about the central ice-cap, which suggests that other outcrops of a plutonic nature are hidden beneath the ice-cap.

The granular rocks there located are sufficiently similar to the effusive magmas appearing elsewhere on the island to suggest a close relationship. It seems probable that these granular rocks are plutonic congelations at moderate depth of the same magmas which, by their outpouring, produced the bulk of the rock formations composing the Archipelago. Where they occur in the west of the island, erosion, both marine and glacial, has been greatest. There is reason to suppose that there also elevation has been more marked than on the east side of the group. Thus greater opportunity has presented itself in that area for removal of the cover from intercrustal injections. In the absence of more definite information we must agree with Lacroix in his contention that these granular rocks are doubtless injections into the overlying igneous effusive series.

Several investigators have recorded at Kerguelen loose boulders of compact crystalline limestone. Aubert de La Rüe, examining these microscopically, found them to contain traces of globigerina. They therefore correspond to similar compact white limestones found as fragments in tuff beds at Heard Island and at Macquarie Island. In these latter localities they have undoubtedly been derived from a sea-floor deposit burst through by volcanic forces. The examples recorded from Kerguelen are therefore no doubt fragments weathered out of volcanic breccias.

It is to be noted that the Kerguelen Archipelago and Heard and Macdonald Island are but minor subaerial features of a vast submarine rise from the floor of the deep Southern Ocean. We have recently traced this submarine feature far to the south-south-east of Heard Island, where it extends into truly Antarctic latitudes. In the past speculation as to the nature of this submarine plateau has favoured the view that it may represent a continental land mass now submerged. But the petrological evidence available indicates that it is to be regarded rather as an igneous blister on the deep ocean floor culminating, where marked effusion has taken place, in the several island groups.

This view does not in any way contravene the possibility that at some time or other a much larger area than the present may have appeared above the surface of the sea. In fact such may have been the case if only during the low sea-level stage of the peak period of the Pleistocene glaciation. In this connection however estimates of the effect of shrinkage of the sea at that time are faced with uncertainty as to the concurrent negative isostatic movement of the land under ice load.

The geological sequence so far revealed may be summarized briefly as follows: De La Rüe mentions blocks of Uralitized dolerite met with among some of the igneous debris. This material he refers to some ancient terraine existing in the crust below sea-level, of which fragments have been brought to the surface during volcanic convulsions. The oldest formations yet met with *in situ* are fluviatile boulder beds intercalated between irregular sheets of basalt. Such are to be observed in the neighbourhood of Jeanne d'Arc and Swains Bay, where they extend from an unknown depth below the sea to a height of over 300 feet above beach-level. The boulders are all igneous, com-

Air photograph of the crater of Mount Ross, looking south-west

posed of a variety of types, basaltic as well as an abundance of trachytic and andesitic forms. In these fluviatile beds, several lignite-bearing horizons have been located. Ross's expedition was the first to discover this lignite. It occurs in seams too thin and too irregular in extent to command attention from an economic standpoint, but some of the seams have yielded important fossil evidence.

A collection of fossil plant remains made by Aubert de La Rüe from the Jeanne d'Arc beds has, above all, proved valuable in the determination of species. Most notable has been the identification of an Araucarian very like the Norfolk Island pine of to-day. Leaves of monocotyledons resembling Nothofagus and others allied to the Myrtacaea were also obtained. This evidence indicates a Tertiary age for the beds. De La Rüe's conclusion is that the lignites are lower Eocene or at latest Oligocene. This he thinks will allow a sufficiency of time for the subsequent events prior to the oncoming of the Pleistocene glacial cycle. But by analogy with Australian Tertiary geology it seems more probable that the Kerguelen lignites are not older than the late Oligocene and may even be early Miocene.

How long these igneous extrusions with intercalations of fluviatile beds had been accumulating before the upper lignites were laid down cannot be definitely resolved, but their development was doubtless a feature of most, if not all, of the Oligocene, thus coinciding with the earlier stages of the great crustal revolution so much affecting the south-eastern Pacific and the region to the north of the Indian Ocean, which movements culminated in the Miocene.

Above the lignite beds at Jeanne d'Arc is a further succession of thick basaltic flows separated by but little tufaceous matter. The comparative absence of the latter and also of scoriaceous phases, together with the great thickness and flatness of the flows, argues for a succession of fissure eruptions. Many hundreds of feet above the lignite horizon, possibly 1500 feet, beds of marine shallow water origin appear with abundant fossil mollusca. These beds are well represented on the Poincaré and Prince of Wales Peninsulas. H. O. Fletcher of our expedition rediscovered this bed at the Cat's Ears. A preliminary examination of these fossils suggests a Pliocene age and warmer waters than now exist at Kerguelen. It is therefore likely that the main bulk of the massive basaltic flows of the island are Miocene.

The Miocene outpouring was evidently accompanied by a sinking relative to the sea. But this was followed by further igneous activity entombing the marine beds and accompanied by elevatory movements. Volcanic extrusions continued after the deposition of the Cat's Ears molluscan bed. Amongst these late contributions are to be recognized basalts, andesites, trachytes, and phonolites. The grandest feature of late effusive activity is the Mount Ross volcano. This was of the violent explosive type and still exhibits a large crater now filled to overflowing with ice, through which a central spine-like plug protrudes. This great outburst broke through the thick series of flow basalts already alluded to as probably Miocene, and is therefore referred to the late Pliocene, but volcanic activity appears to have continued in minor degree into the Pleistocene. The convulsions of which Mount Ross gives witness would certainly be associated with earth movements sufficiently shattering

to give a lead to subsequent eroding agencies in the development of the magnificent fjord system in the basaltic series.

The climate of the Oligocene was comparatively warm as indicated by the fossil vegetation of the lignites and the deposits of globigerina ooze in the seas thereabouts, fragments of which have been ejected by the subsequent volcanic outbursts. Then followed cooler conditions in the Pliocene as illustrated by the molluscan beds at the Cat's Ears. Severe glaciation followed in the Pleistocene, but the severity of the climate has been greatly ameliorated in recent times as is indicated by a general recession of the glaciers to higher elevations. As diatom remains now dominate the deep-sea oozes thereabouts, it is obvious that the neighbouring seas are still much colder than was the case in the Oligocene when globigerina bulked as the most important constituent.

Everywhere in the Kerguelen Archipelago there is evidence of extensive erosion having been accomplished by ice. In fact the present land topography probably owes most of its features to the work of ice. The fjord system may have been begun by water and the finishing touches may be the work of water, but glacial erosion has surely been the main factor. The island and skerry region of the Gulf of Morbihan appears to exemplify the work of sheet-ice erosion over a flat-lying terrain of very varying resistance to erosion. Thick basalt flows and centres of effusion have resisted erosion, whilst less massive flows and tuff beds have succumbed. Superimposed upon this general sheet erosion are to be noted certain definite, deeply cut glacial grooves. Notable examples of the latter in the south-eastern portion of the island are Greenland Harbour and Bolinda Arm, which were formerly continuous but are now separated by a transverse moraine dump, known as Castaways Haulover; also the Carl Luyken Arm and on a still larger scale Swains Bay, where around much of the margin the containing walls rise abruptly to a height of a couple of thousand feet.

Sheet erosion by ice is excellently illustrated in the basaltic region west of Observatory Bay where innumerable rock-basin lakes are studded amongst erratic-strewn, ice-smoothed basalt hills which, having been moulded by ice coming from the west, have their steeper faces to the east. The ice accumulations must have been greatest on the west side of the island. There not only must the land have been completely ice-capped, but the land ice, no doubt, extended as partly floating, partly grounded shelf-ice over the sea. Such an ice mass along the seaboard would be expected to protect it from marine erosion. On the warmer east and north coasts, away from the centre of maximum accumulation, the development of valley glaciers would be favoured. Also there would be plentiful thaw waters to assist in valley cutting. To what extent volcanic activity continued after the beginning of glaciation is not yet clear, but in any case it cannot have been extensive.

In such a troubled region of the Earth's crust there must have been repeated oscillatory movements affecting the Archipelago during its long history. Low raised-beach flats are a feature in many places around the coast, pointing to small elevatory movements of the land since the recession of the ice. This may be the effect of slow isostatic readjustment following upon the unloading of the Pleistocene ice-cap. On the other hand the gradual restoration to the oceans of water withdrawn as ice piled upon the ice-capped regions of the world in

Pleistocene times must have the effect of raising sea-level, resulting in the drowning of the land. One sees in the channels between some of the islands in the Gulf of Morbihan good evidence of flooding. Consequently a rise of the sea in relation to the land since the channels were formed is quite definite. Thus both positive and negative movements are attested.

The present climate at Kerguelen is typically Subantarctic. That is to say it has a low average temperature, but a comparatively mild winter. Figures relating to the south-east of the Archipelago quoted by other authorities are as follows: mean temperature in degrees centigrade of spring+3; summer +6·2; autumn+2·5; winter+0·8. The mean daily amplitude of the temperature in summer is given as 6·5° C., in winter only 5° C. Rain and snow falls at any and all times throughout the year. Stormy conditions are a prevailing feature of those latitudes. On or adjacent to the land at Kerguelen there is an additional wind factor, knowledge of which is important to navigators, namely, that without warning a strong gale of wind may suddenly volley down from the highlands and rake the harbour and coastal waters. Records are plentiful of ships having thus been driven ashore in the harbours.

Such a climate is favourable to the development of peat. Large areas in the east and south-east of the Archipelago are covered with herbaceous and creeping vegetation, the accumulation of which has formed peat beds over as much as about 25,000 acres according to Aubert de La Rüe. It is not found above a height of about 1000 feet. The beds probably never exceed a few yards in thickness. Peaty accumulations in shallow ponds are often associated with deposits of diatomaceous earth.

Vegetation

Arborescent vegetation is wanting. The deciding factor against real tree growth appears to be the prevalence of high winds. Nevertheless on the lower land a dense cover of more humble vegetation is to be found. *Acaena* and *Azorella* are the more ubiquitous elements; but various forms of Ranunculus and Tussock grass are abundant enough in some localities. The interesting form of vegetation known as Kerguelen cabbage (*Pringlaea antiscorbutica*) is widely distributed. This was valued by the sealers as a vegetable for its anti-scorbutic properties. It is a thick, fleshy-leaved plant which, when boiled in several successive waters, becomes reasonably palatable.

Altogether a very large variety of herbaceous plants thrive on the island, but only at low elevations. At a height above the sea of more than 1300 feet large areas are nearly devoid of any plant life beyond mosses and lichens. However a few of the hardier forms like *Azorella* may be found in small isolated clumps even in most unfavourable localities.

Animal population

Life in the sea exists in great abundance though there is a poverty of fish in the shallower waters. The land waters support very little visible invertebrate life and are quite devoid of fish. The shores are the haunt of the sea-elephant and formerly also of the Southern Fur-Seal now extinguished so far as Kerguelen is concerned. Even the sea-elephants are reduced to an infinitesimally small number compared with the population of one hundred years ago.

Vegetation on Suhm Island

Looking west over Lakes Kerr Grant, Richardson, and Campbell

In those days unbridled slaughter was practised, and even now the rape of life continues without satisfactory safeguards to ensure the permanence and adequate stocking of these creatures.

Penguins of several varieties seek Kerguelen's beaches during the incubating season. The magnificent King Penguin, formerly so abundant, is now a rarity. They, together with Rockhoppers, Gentoos, and Macaroni Penguins, existed in incredible numbers before toll was taken of them for their oil by the exploiters of last century.

Of less conspicuous bird life there still remain legions in infinite variety. The albatrosses, petrels, prions, gulls, and terns of the vast Southern Ocean, all know it as a rendezvous in the breeding season. The more virile species nest amongst the herbage of the valleys and the hillsides throughout the island, often far from the sea. The more timid species, including the prions and most of the petrels, conduct their hatching operations in deep burrows safely hidden away from the marauding skuas. For further safety they enter and depart from these underground havens only during the night hours. The only representatives of what may be termed land birds are an endemic teal duck and the spoonbill, or paddy. The latter is a relative of the plover, but is considerably specialized for life along Subantarctic shores. Of invertebrate land life there is a considerable range, but curiously restricted in character.

The introduction by man of rats, rabbits, and dogs has been most unfortunate. The first of these pests was accidentally transported by the vessels of the old-time sealers. The rabbits were brought there by the 1874 Transit of Venus Expedition with the specific purpose of attempting to establish them on the island as a source of food for shipwrecked mariners. They have multiplied to such an extent that the more succulent elements of the vegetation on the main island have been eaten out, and the natural plant assemblage destroyed with repercussions in the native animal inhabitants.

Occasional wild dogs are met with wandering over the land in search of nesting birds and seals which they destroy. These animals are said to be descended from odd sledge dogs left by the *Gauss* Expedition. No doubt this is but one of several sources. Both the dogs and the rats must inevitably exert a steady depopulating effect upon the birds and the seals.

There is no permanent settlement on the island, though in recent years the lessee has arranged for a representative to reside at Port Couvreux, the more effectively to establish his title. Whaling and sealing rights have been sublet to various concerns which from time to time have carried on operations in those waters. One of the most notable of these enterprises transported there from Norway a complete land station for whaling operations. This was erected on Buenos Aires Channel about 1908, and was maintained for some years. In more recent times operations at this station, known as Port Jeanne d'Arc, have been suspended.

Note on the Map.—The accompanying Map of South-Eastern Kerguelen is based upon the surveys of H.M.S. *Challenger*, supplemented by the charts of Du Baty and De La Rüe (see notes at foot of p. 18).

Our motor launch explored the heads of uncharted fjords, and we took a large number of air-photographs, from which the detail on the surveyed portions of the map has been improved and the outlines extended.

Looking west over Lakes Kerr Grant, Richardson, and Campbell

DISCUSSION

Before the paper the PRESIDENT (Admiral Sir WILLIAM GOODENOUGH) said: When Chevalier Yves Joseph de Kerguelen-Trémarec sighted in 1771 the island in the Southern Seas which now bears his name, he thought he had found a part of the great Australian continent, a southern paradise. The name of his ship was an encouraging omen, for she was called *La Fortune*. He came back, made his report, and returned to the island in the following year, this time with two ships, one named *Le Gros Ventre*, so named, I presume, because of her shape or her large carrying capacity, the other *L'Oiseau*. One boat landed from *L'Oiseau*. Kerguelen himself, in *Le Gros Ventre*, did not effect a landing. He lay for a month in a bay to the south-west of the island, after which he returned to France, and, in his disappointment, renamed the island that of Desolation. It is in fact neither a paradise nor entirely desolate. It is an island of great contrasts: there are hot springs alongside glaciers. Nature has had a great struggle in it. At one time the very excellent Kerguelen cabbage grew there, but it has now been almost destroyed by rabbits introduced, I am ashamed to say, by a brother officer of mine at the time the expedition went to see the transit of Venus.

The island has attracted many visitors, and of these I will speak later. One of the visitors, and the latest, was Sir Douglas Mawson. It would, of course, be absurd for me to make that introduction to Sir Douglas which I and my predecessors have made of lecturers from this platform; one may be certain that everything of importance on the island has been closely observed by him.

Sir Douglas Mawson then read the paper printed above.

The PRESIDENT: Sir Douglas has taken us over a very large number of subjects, all of them interesting. He touched on visitors enough to show what a great deal of interest there is in a small island. It is interesting to notice that there are on the Admiralty Chart no less than eight different names of people who have surveyed the place and of four different nationalities—French, British, Norwegian, and German—and all of them have left an indication of their presence by the names which they have given to different parts of the island. As a general rule, we in this Society think it a horrible practice to introduce new names where there are native names. In an island like Kerguelen there were, as you can imagine, no names before, and explorers had fairly good authority for doing what they did. As Mr. Bertram Thomas discovered, they had Biblical authority, for in the forty-ninth Psalm it is written: "Their inward thought is, that their houses shall continue for ever. . . . They call their lands after their own names." So I suppose it was a practice in those days, as it is now, for explorers to give new places their names.

Then in the Sailors' Bible, or the Sailing Directions, you will find a very interesting historical account of the various people who have been to Kerguelen. Hooker, who was there in 1840, writes in his 'Flora Antarctica' that his investigations, like Sir Douglas Mawson's, showed that the island deserved a better name than the Island of Desolation, for there were remains which revealed that it had been at one time a fertile and forested island. He, and Captain Cook before him, and others—whether they had better digestions than Sir Douglas and his friends I do not know—made a great deal of use of the cabbage. Kerguelen's book, of which we have a copy here, is very hard to come by, for after he had written it he added a chapter—not geographical at all—calling attention to the maladministration of the French Government in comparison to others. The French Government of the time impounded all the copies of the book they could get hold of and burnt them. So we are fortunate to possess a copy. Dr. Mill has another, and these are the only two I know of.

I do not know what the object of introducing the rabbit to the island was: whether it was thought people were going to live there or not. There are however two residents of which the island is quite free, winged insects being one and fish in those lakes that you have seen another, according to de Boissière; and unless the French have recently put anybody to live there to look after and take charge of the island there are no human beings resident there. I believe however Sir Douglas heard there was a Frenchman, his wife, and daughter living there, though no visits were exchanged on either side.

It is somewhat interesting to note that when Captain Raymond du Baty was there on the adventurous journey he made in the *Charcot* he found German papers that had been left on the island by the German expedition which went to watch the transit of Venus, and he and his brother beguiled themselves by reading the German account of the Franco-German War and comparing it with his own papers of which he had copies with him.

The Norwegians went so far as to erect a lighthouse and to keep it going on the island at one time for their own people when they went sealing, but, as you have heard, whales have left the island and whaling has been discontinued. The only other person I know of who refers to the island—and I am indebted to Sir William Gowers for supplying me with this—is Rudyard Kipling, who quotes it in some of his lines in 'McAndrew's Hymn.' Incidentally, Sir William Gowers told me that he did not know anything about the island, and I dare say prior to the lecture there were many others who also knew very little about it. By coming here this evening and describing the island so thoroughly and so interestingly Sir Douglas has added to the great debt which this Society already owes him. Few have done more in real exploration of all kinds, whether it is natural history or geology or geography in all its branches. One realized, as Sir Douglas talked, how much he really cares for the preservation of life of all kinds in the Southern Seas that he has sailed so long and which he knows so well. I dare say some of you saw his film last week, and I had an opportunity then to say how much we had enjoyed it and how much I hoped it would have a very good exhibition both in this and other countries, especially before the youth of the nation, to show them how men could go through those great hardships in the prosecution not only of their duty but of their profession. I ask you, Sir Douglas Mawson, to accept, on behalf of this audience and the Society, our very sincere thanks for coming here again, as you have been here before, to give us the result of your experience and to do it in a way which has charmed us all.

Note by the Editor G.J.

To facilitate description in the above paper and in the further publications of his expedition Sir Douglas Mawson has found it necessary to assign names to prominent topographical features hitherto unnamed. In accordance with practice the Map bears the legend: New names on this Map are as proposed by Sir Douglas Mawson.

THE EXTINCT WATERWAYS OF THE FENS: *A paper read at the Afternoon Meeting of the Society on 13 November 1933, by*

MAJOR GORDON FOWLER

A NOTE in the March 1932 issue of this *Journal* drew attention to the presence of certain extinct waterways in the south-eastern or peat-covered part of the Fenlands of East Anglia which I called Roddons and Old Runs.

Roddons

It was pointed out then that Roddons presented themselves as generally meandering banks of laminated silt, except where ploughing or digging had reduced them to the level of the land, and that their raised position was due to differential shrinkage or wastage as between the silt which had been deposited in their beds when they were active waterways and the deep peat through which they had once flowed.

More has been learned about Roddons since then. Their silt has been proved to be of marine origin and to have been deposited by tidal action.[1] Another indication of the marine nature of the water that deposited the silt is found in the fact that the skeletons of a pair of 14-foot adult whales (*Pseudorca crassidens*) were once found in a ploughed-down Roddon. Dr. Macfayden and the writer learned this in 1932, after Dr. J. R. Garrood had pointed out the exact spot where he dug up the whales in 1921. Dr. Garrood published the account of his find in 1924,[2] or long before Roddons had been recognized, so it does not indicate the exact nature of the site. This Roddon is one of a complex system in Bassenhally Moor, about 7 miles east of Peterborough and 14 miles from the nearest sea-coast. With few exceptions Roddons appear to be the courses of natural waterways which at some time or other have been diverted by human agency into straighter channels for the purpose of either better drainage or more direct water transport. Objects of Romano-British origin have been found in many of them and along their banks, and in the neighbourhood of some of the largest many domestic occupation sites of that period are being discovered. Subject to further investigation it appears that in Romano-British times the Fenlands did not require to be defended from sea or overflowing river water by banks along the coast and rivers, and that at least the upper part of the silt in Roddons was deposited during later times. There is no evidence that the ancient bank which runs all along the pre-seventeenth-century coast-line of the Fenlands is of Roman origin, though in places it is undoubtedly earlier than the eleventh century.

Old Runs

In the note in this *Journal* already referred to Old Runs were described as deep and steep-sided channels in the buttery blue clay which underlies the

[1] Fowler, "Fenland Waterways, Past and Present," part 1, appendix 1, by Dr. W. A. Macfayden, *Proceedings of Cambridge Antiquarian Society*, vol. 33, p. 125.

[2] *Proceedings Zoological Society*, part 1, p. 12, 1924.

peat in most places in the south-eastern part of the Fens, filled with a greasy kind of peat and appearing to belong to a time before the formation of the present surface peat bed.

Only a little more has been learned about Old Runs since then. No large ones have been found. Many of the larger Roddons appear to have been partly peat-filled but still active Old Runs when the tides bearing the silt which eventually made them Roddons first invaded their channels. Those Old Runs which are close to little Roddons appear to have become extinct by natural agency before the latter were formed, but those found farther inland, such as near Cambridge, where the land is higher and there are no Roddons, seem to have survived as active waterways to a much later date and been diverted by human agency. The buttery blue clay through which Old Runs meander is to a large extent of marine origin.[1] The Mollusca found in Old Runs indicate that the water that once flowed in them was fresh, slow running, and not subject to desiccation in the summer.[2]

Since my original note in this *Journal* three more types of extinct waterways have been observed, known as Old Slades, Old Ways, and Old Creeks.

Old Slades

These have the same appearance as Roddons except that shell marl takes the place of silt, which seems to indicate that they were beyond tidal influence when they were active streams. Their raised position is also due to differential shrinkage. No large ones have been found. Their shell marl is so unfertile and impedes agricultural processes to such an extent that most Old Slades have been levelled to the ground in recent years. Most of the course of the Old Slade in Isleham Fen can be seen now as only a band of lighter-coloured soil about 40 feet broad scattered with fragments of little shells, but its bed is about 3 feet below ground and rich in relics of Romano-British times.[3] It is connected with the upper reach of the fenland part of the River Lark, and joins that river again lower down at a place named Lark Hall. The word "Slade" is a dialect one which was sometimes used to denote a low wet place, but to-day, with the prefix "Old," it is used by local fenmen for the still unlevelled part of the course of the extinct waterway mentioned above, which is high and dry compared with all the land for miles around. No doubt before the drainage of Isleham Fen the course of this waterway was low and wet, as is implied by the word "Slade," though its meaning is diametrically opposite to the conditions of to-day. An Old Slade in Swaffham Fen, Cambridgeshire, has proved to be the relic of a Romano-British canal,[4] though till lately its straightness and raised position and the fact that Romano-British objects had been frequently found in and beside it had led every one to believe that it was a Roman road. The purpose of this canal seems to have been water transport to the Cam of clunch quarried at Reach.

The above examples of things not being either what they are called or what they appear to be are only two out of the many queer results which have

[1] Fowler, *ibid.*, Appendix 2, pp. 126, 127, note 1.

[2] Fowler, *ibid.*, Appendix 3, p. 128, by Mr. A. S. Kennard, note 1.

[3] For instance, Lethbridge and O'Reilly, "Archaeological Notes," *P.C.A.S.*, vol. 33, p. 166.

[4] Fowler, *ibid.*, p. 114, note 1.

followed from the discovery of the nature of the extinct waterways of the Fenlands.

Old Ways

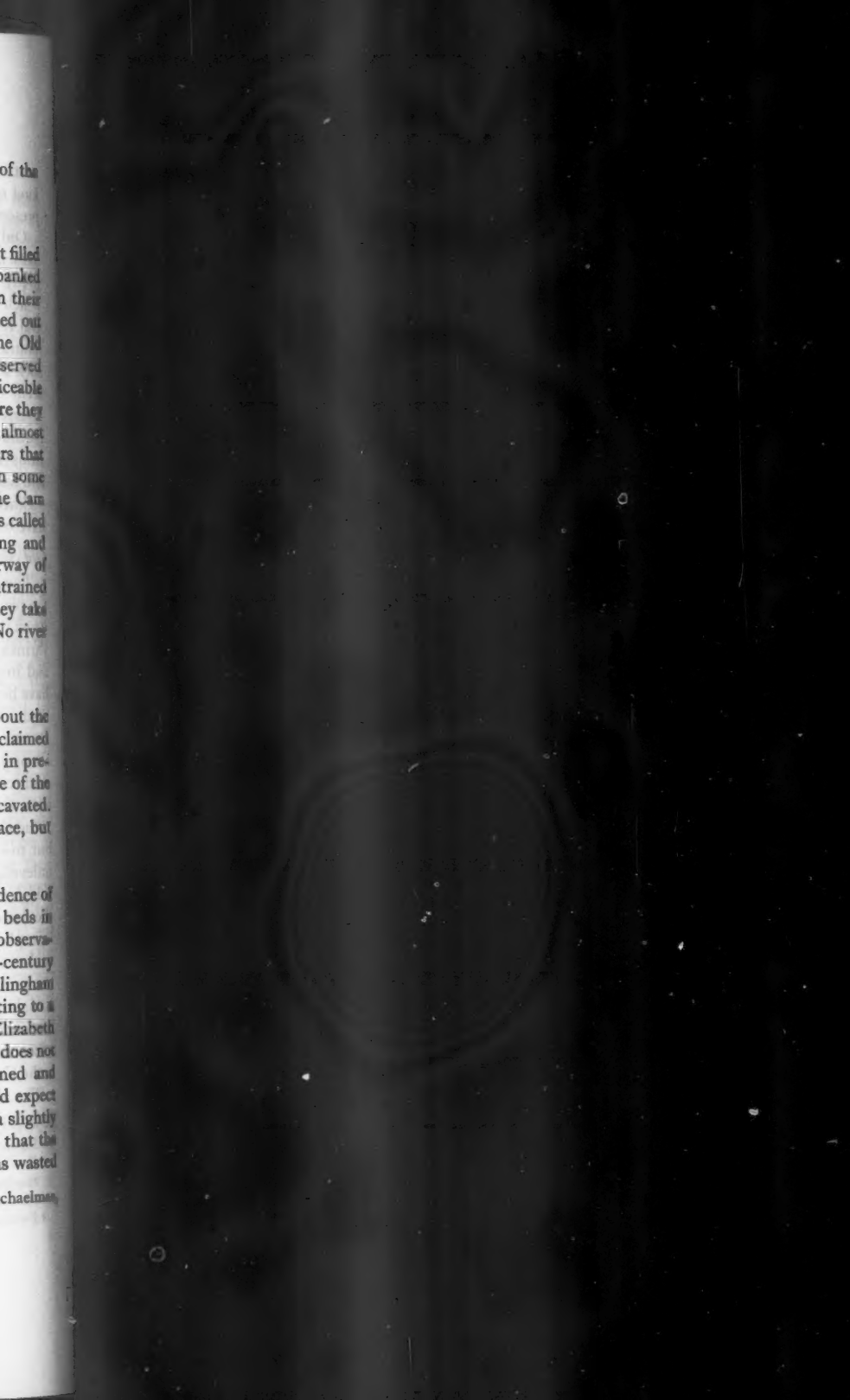
These are a sort of cross between Roddons and Old Runs. Where not filled in by ploughing or digging they appear as concave channels lined and embanked with silt and partly filled with greasy peat. The silt below the peat in their beds is suspected to be of considerable thickness. Borings to be carried out this coming summer should throw some light upon this subject. The Old Ways in the northern, or silt-covered part of the Fenlands, when preserved in old grassland which has never been ploughed, present very noticeable concave beds with only a very little peat or black earth in them, but where they have been filled in they leave so few signs of their presence as to be almost untraceable. In most cases, Old Ways are the relics of the largest rivers that at one time passed through the Fens to the sea, and seem to have been some of the last to be diverted. The diversion of part of the Old Way of the Cam between Cuckoo Bridge east by north of Ely and Littleport (which was called the Great Ouse) took place as recently as 1830. Owing to ploughing and filling in near Prickwillow the course of this great abandoned waterway of only one hundred and four years ago is so unnoticeable to the untrained eye that it may be used for the convincing of sceptics who, when they take my maps into the field, are apt to say "Bunkum! I can see nothing. No river or watercourse ever went this way."

Old Creeks

These are the relics of the many little creeks that meandered about the northern or silt-covered parts of the Fenlands when they were unreclaimed Salt Marshes. At present, we do not know whether they were active in pre- or post-Romano-British times, but may do so before long when some of the numerous Romano-British domestic occupation sites there are excavated. These little creeks provide very few signs of themselves on the surface, but show up well on air photographs.

A note of mine in the February 1933 issue of this *Journal* gave evidence of the remarkable amount of shrinkage or wastage of the surface peat beds in the Fens when subject to drainage and cultivation. There is one new observation to report with reference to that subject. Most early seventeenth-century maps show a large mere on the south side of the Old West River in Willingham Parish, Cambridgeshire. An original MS. in the Record Office relating to a dispute about certain land there shows that in the time of Queen Elizabeth this mere was about 80 acres in extent and $16\frac{1}{2}$ feet deep.[1] The mere does not exist to-day, and the neighbouring land has long been well drained and cultivated, but considering the original depth of the mere, one would expect to find its site a concavity of some sort. On the contrary, one finds a slightly raised plateau of about 80 acres of shell marl. This can only imply that the mere was originally in a peat bed more than $16\frac{1}{2}$ feet thick, which has wasted

[1] P. R. O. Exchequer Depositions by Commission, 17th/18th Elizabeth, Michaelmas, Number 6.



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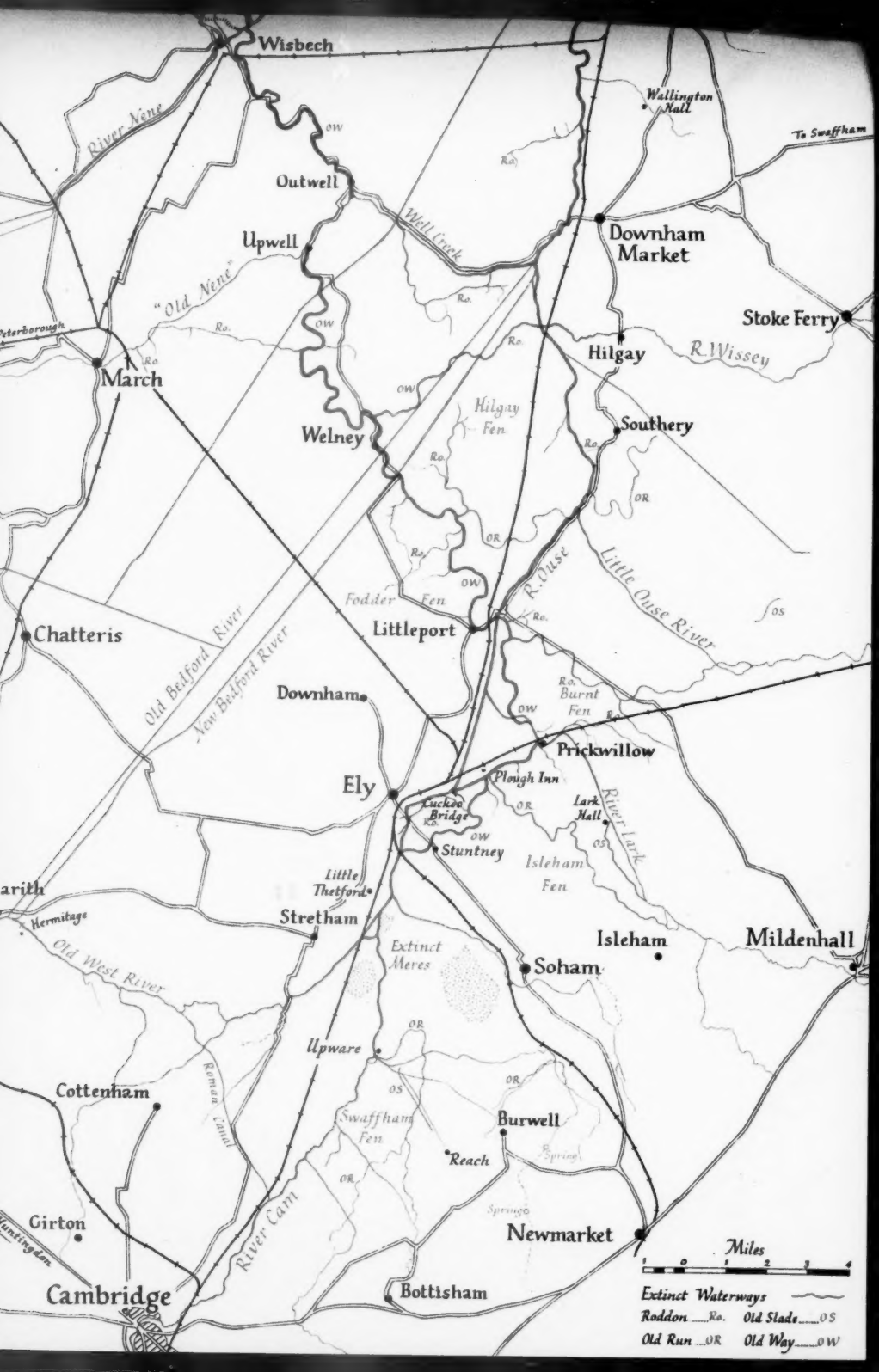
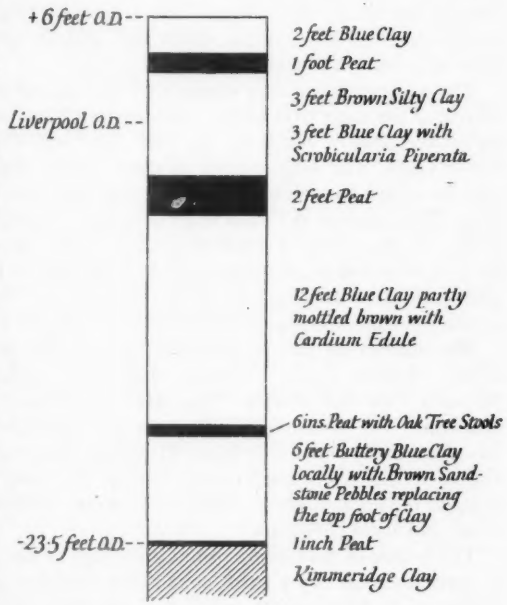

Wisbech
River Nene
Wallington Hall
To Swaffham
Outwell
Upwell
Well Creek
Downham Market
"Old Nene"
Stoke Ferry
Hilgay
R. Wissey
March
Hilgay Fen
Welney
Southery
R. Ouse
Little Ouse River
Fodder Fen
Chatteris
Littleport
Old Bedford River
New Bedford River
Downham
Burnt Fen
Prickwillow
Ely
Plough Inn
Cuckoo Bridge
Lark Hall
River Lark
Stuntney
Isleham Fen
Little Thetford
Hermitage
Stretham
Extinct Meres
Isleham
Mildenhall
Soham
Old West River
Upware
Cottenham
Roman Canal
Swaffham Fen
Burwell
Reach
Girton
River Cam
Newmarket
Cambridge
Bottisham
Miles
0 1 2 3 4
Extinct Waterways
Roddon ..... Ro.
Old Slade ..... OS
Old Run ..... OR
Old Way ..... OW

away owing to the drainage of the mere and surrounding land. There appears to be no record of when that work was commenced, but the history of the drainage of that area in general points to a time about the end of the seventeenth century. However, time is not a factor in the wastage or shrinkage of peat; it depends much more upon the thoroughness of the drainage which lets in the air and allows bacteria to attack the vegetable fibres in it, and upon the intensity of its cultivation which aids the aeration and also assists the compacting that follows the drawing off of the water.

The accompanying diagram illustrates a section of the post-glacial Fenland deposits exposed during the excavation for the foundations of the new pumping engine plant at St. Germans about 4 miles south of King's Lynn. Though what can be learned from this section may not have a great deal of bearing upon the subject of extinct waterways and the many problems relating to them which have still to be solved, it is of sufficient geographical interest to justify brief attention here. The floor of the Fenland basin at St. Germans was once a land surface of Kimmeridge Clay and appears to have been at least 60 feet above sea-level in the Mesolithic or Boreal period. At that time, which, shall we say, was about 5000 B.C., part of the North Sea was a peat-covered fen[1] through which meandered northward the waters of the Rhine, Great Ouse, and adjacent rivers.[2] Later on, about 3000 B.C., subsidence took place, the North Sea came into being, and this old land surface at St. Germans became badly drained. This caused a thin peat bed to form over the Kimmeridge clay, and in it grew a forest of trees suitable to their environment and the prevailing climate. The subsidence went on and the sea broke in to make brackish-water lagoons and cover up the first peat bed with buttery blue clay. Then either a temporary cessation of the subsidence, or a slight re-elevation


+6 feet O.D.
Liverpool O.D.
-23·5 feet O.D.
2 feet Blue Clay
1 foot Peat
3 feet Brown Silty Clay
3 feet Blue Clay with Scrobicularia Piperata
2 feet Peat
12 feet Blue Clay partly mottled brown with Cardium Edule
6 ins. Peat with Oak Tree Stools
6 feet Buttery Blue Clay locally with Brown Sandstone Pebbles replacing the top foot of Clay
1 inch Peat
Kimmeridge Clay

Section of the Fenland Deposits at St. Germans

[1] Grahame Clark, 'The Mesolithic Age in Britain,' p. 115.
[2] See Reid, 'Submerged Forests,' 1913, map facing p. 41.

took place, the sea was excluded, and fresh water once again collected to form the second and thicker peat bed which provided a new land surface and another forest. And so the process of repeatedly checked subsidence went on till four distinct forest-bearing peat beds or land surfaces had been formed and covered up in this locality.[1] As the floor of the Fenlands graded up farther inland the process was retarded so that in the neighbourhood of Ely where most of my exploration and mapping of the extinct waterways has been so far carried out, one finds in most fens only two peat beds, the present surface one and another separated from it by the buttery blue clay already referred to, which in some places is as much as 12 feet thick. It is also worth noting that the peat a few inches above that clay in Burnt Fen, near Ely, was a wet land surface in Early Bronze Age times, that is to say, about 1500 B.C., and that the natural bed of the Little Ouse River there, which now appears as a Roddon, took at that time very nearly the same course as at present.[2]

The accompanying map shows both the natural and artificial parts of the course of the main river of the south-eastern Fenlands and those of its tributaries, the chief of which are the Lark, the Little Ouse, the Wissey, and the Great Ouse. The extinct parts of these various waterways are marked red and the extant ones blue, and the types of the former are also indicated on the map. The name of the main river in question seems never to have been the same over the whole of either its present or past courses. Above Cambridge, its present course is called the Granta, from there to Little Thetford the Cam, and from there to King's Lynn the Great Ouse; but up to the seventeenth century it was sometimes called the Granta as far down as Little Thetford.

The abandoned part of its course between Ely and Prickwillow has been called "Rollers Lode," between there and Littleport "The Old Way," between there and Welney "The Old Croft River," and between there and Wisbech "The Wellstream." However provided a branch of the Great Ouse never originally joined it at Little Thetford,[3] then over the whole of its natural course it was really the Granta swollen by many tributaries as it flowed towards the sea at Wisbech. That is the name which will be used for it in order to try and avoid confusion.

The course of the Granta from Cambridge to just north of Little Thetford is natural except for a small abandoned meander at Upware. The natural course of its little eastern tributaries over that distance are shown to have entered it at the latter place. Its only western tributary, now called the Old West or Great Ouse, was originally a little stream whose headwaters were cut off by a Roman Canal called the Car Dyke. Even to-day to call the river below Little Thetford the Great Ouse is misleading, as none of the water of the latter river has passed that way since a sluice gate at the Hermitage near Earith and an artificial canal there called the New Bedford or 100 Foot River were constructed in the middle of the seventeenth century.

From just north of Little Thetford the map shows that the Granta used to

[1] See H. and M. E. Godwin, "Pollen Analyses of the Fenland Peats at St. Germans," and W. A. Macfayden, "The Foraminifera of the Fenland Clays at St. Germans," *Geological Magazine*, April 1933, pp. 168, 182.

[2] Grahame Clark, "Bronze Age Site in the South East Fens," *Antiquaries Journal*, vol. 13, no. 2, p. 266.

[3] Fowler, *ibid.*, pp. 117–124, note 1.

take a meandering course to Prickwillow, being joined on its way by the now extinct course of the Lark and, among others, a little stream, which must have had its source in the springs along the south-eastern edge of the highlands of Ely. Originally the lower part of this little stream, where it touched a tongue of the highlands near Turbutsea, must have been the only means of water transport to hard ground for the ancient inhabitants of Ely. This explains the twelfth-century and earlier references to the inaccessibility of Ely. If the river had run as at present right along a high-and-dry frontage the city would not have been so inaccessible in those times. This is but one example out of many which could be quoted to show how the mapping of the natural river system of the Fens casts fresh light upon local history.

The first and noticeably straight mile of the course of the Granta abandoned in 1830, that is to say the part between Cuckoo Bridge just east by north of Ely and the Old Plough Inn on the Middle Fen Bank, must have been dug or embanked to take the waters of the Granta when they were first diverted to the highlands of Ely. Archaeological finds in the natural bed of the Granta farther eastwards[1] suggest that the diversion in question took place about the early part of the twelfth century. If that is so, the river flowed over that straight mile for at least seven hundred years, but my excavations in it show that a channel no deeper than the top of the buttery blue clay, 2 feet below the peat, was ever eroded there. This provides a striking demonstration of how very slowly river beds are eroded in even the softest alluvial deposits when the fall to the sea is slight. The deepest part of the pre-1830 bed of the natural course of the Granta, which commences at the other side of the Plough Inn, was not found when I bored down 16 feet. It is suspected that it is not less than 20 feet deeper and cut well into the floor of the Fens. No doubt the natural channel of the Granta here is very old and practically the same as it was when the land was very much higher than at present.

From Prickwillow the Granta meandered to Littleport and was joined on the way by the now extinct course of the Little Ouse. It is seen that the latter river never originally passed to what is now called the Ouse and thence to the sea at King's Lynn. This fact upsets all previously accepted views as to the reason for the excessive flooding of the Fens that eventually prompted the great seventeenth-century and later drainage works.

From Littleport the Granta passed to Welney, joined on its way by many now extinct streams of local origin. The largest of the latter, which seems to have started from somewhere east of Southery, provides the present Ouse with some noticeable meanders before passing on south westward to join the Granta. Thus we see the water of a river of to-day passing along part of the widened channel of a stream of the past, but in the reverse direction. This is not the only example of the artificial reversal of the direction of the flow of water in the Fens. It leads one to believe that if only men had taken note of the way in which Nature chose to drain the Fens and had followed those directions with their artificial cuts, there would not have been so much difficulty in maintaining the drainage of the Fens as has been experienced for centuries past and is still being met with to-day.

[1] Lethbridge and Fowler, "Excavations in the Bed of Rollers Lode," *P.C.A.S.*, vol. 33, p. 129.

From Welney the Granta passed on the line of the county boundary to Upwell, being joined on its way by the now extinct course of the River Wissey —which it will be noted also crossed the line of the present Ouse—and by the now extinct course of a large waterway coming from March, which may prove to be the end of the Great Ouse.

From Upwell to Outwell the Granta followed the present course of what is called the Old Nene and was joined at the latter village by the present Well Creek. The old course of the eastern part of Well Creek is shown on the map as a Roddon in which the water ran from east to west. It is interesting to note that this confirms Skertchley's opinion as to the original direction of the run of the water in this stream, which he arrived at by observing the angle at which it entered the old river.[1]

From Outwell the great river passed with the county boundary to the head of its now reclaimed estuary at Wisbech, but to-day little or nothing can be seen of its bed over that distance except where it was used by an eighteenth-century canal.

The archaeological fruitfulness of some of the extinct waterways of the Fens can be judged by the fact that minor excavations in the original bed of the Granta between Stuntney and Quaveney, near Ely, a distance of a little over a mile, have produced a Roman pewter dish and flagon, a pot of the same period, a Viking battle-axe head, a late Anglo-Saxon pot, and part of another pot supposed to relate to the twelfth century.

DISCUSSION

Before the paper the PRESIDENT (Major-General Sir PERCY COX) said: The paper this afternoon is by Major Gordon Fowler, and is on "The Extinct Waterways of the Fens." Major Gordon Fowler is an engineer by profession, and he is now interested in the sugar-beet industry of the Fens, but he has taken up as a hobby the serious study of the extinct waterways. He published some of his earlier results in two notes in the Society's *Journal*, one in March 1932, and the other in February 1933. The present paper gives an account of more extensive and recent work. Major Fowler is Vice-President of the recently formed Fenland Research Committee, by which we hope that some very definite and useful work will be undertaken in connection with the Fen country.

After the paper the following gentlemen have accepted invitations to speak: Mr. G. C. Dunning, of the London Museum, and Mr. F. H. Edmunds, of the Geological Survey of England. We asked Mr. Christopher Hawkes also to come, but he has written to express his regret, and has sent a note on the subject which the Secretary will afterwards read.

Major Gordon Fowler then read the paper printed above, and a discussion followed.

Mr. G. C. DUNNING: It is not only out of Africa that something new is always coming. Major Fowler has told us about some new things in the Fen district. To the ordinary archaeologist the Fens have an extreme interest. They are rich in objects of all periods, and at various times people have written a great deal about the Fens in the Roman and other periods. Ten years ago Dr. Cyril Fox published his book on the 'Archaeology of the Cambridge Region,' and made certain intensive studies from an archaeological and geographical point of view.

[1] Skertchley, 'Geology of the Fenlands,' p. 68, 1877.

He was particularly careful to plot on maps the finds of different periods in order to show the distribution of the population at various times in relation to the natural features—in relation, for example, to clay, marshland, forest, and so forth. He showed how various natural features have controlled the distribution of man.

Major Gordon Fowler is throwing new light on this history, in particular with his reconstructed maps of the Roddons and other ancient waterways. We shall know much more about the distribution of the agricultural population in the Fenland during Roman and post-Roman times as a result of his researches. The Roddons are always interesting from the point of view of the astonishing things found in them. In particular some of the Roman objects are of very great interest. Major Gordon Fowler has shown us this afternoon photographs of some of the very interesting pots which have been discovered. The one which he showed last of all was an example which I examined at Cambridge a year ago. Major Gordon Fowler appealed to me as to the date of it. It is impossible to date it closely, but I should say somewhere about the eighth or ninth century. There are many curious things in this region, and the Museum of Archaeology at Cambridge is full of objects from the Fens which deserve to be very closely studied. One can only wish the Fenland Research Committee and Major Fowler the very best of luck and compliment him on his perseverance in his researches.

Mr. F. H. Edmunds: It might almost be said that owing to the completeness of Major Fowler's paper, from the geological point of view there is little to discuss, and there is no adverse criticism that could be offered at any point. It is rather a surprise to find that in a district like the Fens Major Fowler has been able to give an entirely new aspect to the origin of the present river-systems and water-drainage.

At the British Association meeting at Hull some eleven or twelve years ago Professor Kendall gave a paper on washouts in coal, *i.e.* local replacement of coal by muds and silts, in which he indicated that while originally there were banks of coal-forming material on a higher level than the silts, which represented old streams, subsequent compression brought the coal material to a lower level relatively to the washout, somewhat in the way the lecturer has illustrated that the Roddons of the Fens have been formed; and it is very interesting to find that Professor Kendall's explanation of a phenomenon of the Coal Measures is similar to that which Major Fowler has given to a present-day occurrence. Major Fowler has proved Professor Kendall's hypothesis.

The Fenland area, apart from its purely surface features, is one of great interest. About two years ago I was taken over some part of the area by Major Fowler, when I had the opportunity of examining a very large excavation in peats and silts. In the section at St. Germans the original land surface was encountered at a depth of about 40 feet, on which there was a thin bed of peat. That was followed by about 4 feet of thick buttery clay, then there was another bed of peat about 1 foot thick, which was followed by silts, and that again by peat, and so on. This sequence indicates that slight earth-movements had occurred, and have to be considered in connection with changes in drainage. Much work remains to be done following Major Fowler's discoveries, and only the fringe of both the "solid" geology and of the "drift" geology of the Fens has been touched.

There is one point on which I should like to ask for further information. At the beginning of his paper Major Fowler remarked that the Roddons near Ely contain marine or brackish water foraminifera, and he concluded that the Roddons were the relics of one-time tidal waterways, although, as he said, he

was rather surprised to find these things so far away from the sea. I think it is quite possible that the foraminifera might have been derived from pre-existing silts; they could have been quite well washed in. This may seem to be a simple point, but the implication is important. If the foraminifera are not derived, their presence indicates the former existence of a post-Roman depression over the area. If these waterways right up as far as Ely are tidal, it might be thought that in such flat country the sea would invade the whole district, and spread a considerable thickness of silt over the area.

The PRESIDENT: Mr. Christopher Hawkes is not able to be present, but he has sent a note on the subject which the Secretary will read.

The SECRETARY read the following note by Mr. CHRISTOPHER HAWKES: The rediscovery of the extinct waterways of the Fens, once initiated on the ground, as Major Fowler has initiated it, may be most fully exploited by means of air photography. In the air photographs which are being taken for the Fenland Research Committee, the same shrinkage of the peat which has shown up the waterways as Roddons is seen to reveal the settlements, roads, and field system of Romano-British times, largely determined by the waterways, and dependent on them. So complete is the picture thus revealed, that there is confident hope that a complete air-survey of the Fens may give us something like an "Ordnance Survey" of this piece of Roman Britain, which was, contrary to former belief, well populated and fully tilled. But the value of these results will not merely be topographical: in what we can perceive of the nucleation of fields around the various settlements, and such differential characters as may exist among the fields so nucleated, we have economic and sociological evidence at hand such as has never been available before. So much has been written on the Social and Economic Structure of the Roman Empire without any contact with work in the field, that this new contribution can hardly fail, even in a remote district like the English Fens, to make itself very appreciably felt. And knowledge of conditions in the Roman Empire, especially agricultural and settlement conditions, brings with it far-reaching implications both backward into prehistoric and forward into mediaeval (and so into modern) times.

Mr. J. M. WORDIE: It is now about three years since Major Fowler made his notable discovery of Fenland Roddons; it is much the most important geological discovery round Cambridge within the last generation, and, moreover, has been made by a non-geologist. I think he deserves every credit for what he has done. After he discovered these inequalities in what is generally regarded as a flat and featureless plain he came to Cambridge and demonstrated them to what I may call the professionals, and we readily admit that he has stolen a march upon us.

One important result has come from his work. He has succeeded in linking up and co-ordinating workers in different branches of science, and they have now formed themselves into a Fenland Research Committee. The Roddons stimulated so much interest that joint action, already suggested and desired, immediately took effect, and the Committee formed itself there and then. The Committee includes archaeologists, geologists, botanists, and others, meeting together as frequently as possible. We are now getting the benefits of their team work directed to intensive exploration of the Fenland, and, as Mr. Christopher Hawkes has mentioned in his letter, it is likely to produce still more important results in the near future.

Major GORDON FOWLER, in reply, said: I think the only question to which I have to reply has been raised by Mr. Edmunds, and I believe I can answer it to a certain extent. He says that if the silt in the Roddons where it occurs inland was of marine origin, it must be supposed that the land near the sea had been submerged in comparatively recent times. The first map that I showed the

Society this afternoon indicated that the northern part of the Fens is covered with silt and the southern parts with peat. I have little doubt myself—although I have not proved it to the satisfaction of geologists—that most of that silt-covered area in the northern part of the Fens was sometimes covered by the sea in comparatively recent times, because without exception all the definite Romano-British horizons that I have so far noted there—definite horizons like hut floors—as well as the east part of the only Roman road we have in the Fens, are covered with at least 15 inches of silty clay of marine origin. I find that the Roddon channels cut down to a very great depth. Mr. Grahame Clark, a member of the Fenland Research Committee, bored through one in the course of his examination of an adjacent early Bronze Age site and found, I think, speaking from memory, that the Romano-British bed of that Roddon appeared to be 6 feet, the Bronze Age one about 16 feet, and the lowest and probably Mesolithic one 26 feet below sea-level to-day. I think the elucidation of all this is not very difficult, and if Mr. Edmunds will come down to Ely again and make a study of the land oscillations he mentions I should be exceedingly glad to be his guide and take him to where he will be able to obtain the evidence he requires. Further, if any of those present or any members of the Society who may be interested in these matters care to write me at Ely I shall be delighted to make an appointment and show them some of the queer things which the Fens reveal. I believe that the Fens provide an almost unexplored field for research into all matters relating to post-glacial times.

The PRESIDENT: We have had an extraordinarily interesting paper, and it is good to think that Major Gordon Fowler has taken up a hobby which evidently has so many possibilities and is proving itself so valuable to geology and archaeology alike. He seems to have touched a stratum which is of great interest and variety for the student. We can congratulate him on what he has already done, and we must express our thanks to him not only for his lecture but for his invitation to any Fellows of the Society to see more of his work in position on the ground.

THE LOE BAR NEAR HELSTON, CORNWALL

H. SPENCER TOY, M.A., B.SC., A.INST.P.

THE Loe Bar is situated on the coast of Mount's Bay, about halfway between Penzance and the Lizard Head. It cuts off the sea completely from the valley running up to Helston, about 2 miles distant, and renders possible the formation of the freshwater lake known as the Loe Pool, or, just as often, simply as the Loe. The name "Looe" is found on some maps, but is not used in the neighbourhood.

The length of the Bar is about a quarter of a mile, if measured along the track used by the carts which cross it occasionally, but the distance from cliff to cliff, if measured between the nearest points, is about 500 feet less than this. The width of the shingle, at the narrowest point, is, at present, about 600 feet from the high-water mark at ordinary tides. This shingle is composed chiefly of chalk-flints. There are no cliffs of this material anywhere in Cornwall, nor are there other beaches of it. The material of which the other beaches in the neighbourhood are composed is identical with that of the cliffs behind them. The cliffs at the Bar consist largely of killas and quartz, and it has been suggested[1] that the flint shingle represents the destruction of a deposit lying not far distant below the waters of Mount's Bay.

The Loe is the largest lake in Cornwall. It is about $1\frac{1}{4}$ miles in length, and its average width is from 800 to 900 feet. Carminowe Creek extends about half a mile on the east side and Penrose Creek a much shorter distance on the west side. The perimeter of the lake is about $4\frac{1}{4}$ miles; the surface area of the water is about 150 acres; in 1859 its depth at a distance of 400 yards from the Bar was 40 feet (*Transactions of the Royal Geological Society of Cornwall*, vol. vii, p. 353). The Pool is fed by the Cober and a few small streams which rise in the hills around it: the Cober supplies fourteen-fifteenths of all the water which falls into the Loe.

Taking the average for the whole year, the River Cober brings into the Loe 2300 cubic feet of water per minute.[2] Some of this drains through the loose material of the Bar. In 1837 "the surface was observed," says Rendel, "to sink for several successive days, 4 inches a day, when it was from 6 to 8 feet above high-water level. This depth of 4 inches over the whole surface, added to the influx of the river, etc., during the same time, amounts to 7,000,000 cubic feet, the quantity lost by filtration in twenty-four hours. The level at which equilibrium is maintained[3] appears to be below high-water spring tides."

In the middle of the nineteenth century a lead ore, rich in silver, was being mined at Wheal Pool, just below Helston ('Victoria History of Cornwall,' vol. i, p. 513). The miners made an adit through the rocks at the north-west

[1] 'Geology of Lizard and Meneage' (Memoirs of the Geological Survey), p. 234.

[2] J. M. Rendel, 'Report on the Practicability of Forming a Harbour at the Mouth of the Loe Pool,' p. 8. There is a copy of this report, without the diagrams, in the Penzance Library.

[3] The adit (see next paragraph) makes it possible to alter the level at will.

end of the Bar in order that the surplus water of the Loe might drain into the sea.[1] When the mine was closed, no particular attention was paid to the adit, and it soon became choked by sand. It remained blocked for many years, until it was reopened by a party of tin-streamers, since which time it has been kept clear by the owners of Penrose. There was and is however always a latent danger of chokage; to minimize this, the adit was enlarged and improved by Captain John Peverel Rogers, the late lord of the manor. The velocity and pressure of the current now flowing through the channel are such that the risk

of stoppage is very small, even during storms, though there is the possibility of such an occurrence: the adit was blocked for some days after the tidal wave in January 1924, and mining engineers were engaged to clear it. At that time the breaking of the Bar was discussed by the Helston Borough Council, as the lower parts of the town were badly flooded.

[1] In the year 1898 an old inhabitant of Helston, the late G. J. Cunnack, compiled his Recollections of the town and district. The manuscript was written in two exercise books, but never published. This is the source of the fact stated above.

Such flooding has always been a serious menace to the town; before the enlargement of the adit it necessitated the artificial breaking of the Bar on several occasions. Before this operation could be undertaken, the Corporation of Helston had to observe an ancient ritual, the origin of which has not been traced. The Mayor procured a stout leather purse, place three halfpence in it, and sent it to the lord of the manor of Penrose, where several such purses are still preserved. At the same time he asked permission to cut the Bar. When this had been granted, a trench was dug in the shingle and the water was allowed to enter it. As soon as communication with the sea was established, the flood through the channel "increased in volume and became a rushing, furious torrent that discoloured the sea to a great distance outside" (Cunnack, *loc. cit.*). Sometimes the collision of the fresh water and the salt was a magnificent spectacle; it was visible "for six or eight miles from the shore," and was often accompanied by great noise. The Bar was last cut in the winter 1867–68, and, before that, in the winter 1865–66.

Before discussing the formation and growth of the Loe Bar we may consider briefly the formation of bars elsewhere.

Steers has shown (*Geogr. J.*, vol. 69, pp. 24–48) that at many places on the East Anglian coast marine erosion has cut back the promontories, and that longshore currents, passing along the shore, have carried the material worn away from the promontories and deposited it across the estuaries. In this way rivers were either deflected by a shingle and sand spit or else were completely dammed. Concurrently with this marine deposition the very fine particles carried by the streams were deposited on the inner side of the spits and bars. Such is the origin of the Norfolk Broads. Gulliver has shown (*Geogr. J.*, vol. 9, pp. 536–546) the effect of the sea over a much longer period and on a much larger scale by the conversion of Appledore Bay into Romney Marsh and Dungeness Foreland. The first stage in the process was an attempt to close the bay by a bar, which grew towards the middle from spits on either side. As soon as these extended far enough across the bay to make the water inside comparatively quiet, aggradation began, the sediment being brought by the streams and by the tides and winds.

It is probable that somewhat similar processes operated in closing the Loe valley. The tides flowing in and out of the haven would have been comparatively strong; some sort of eddy circulation would have been set up between this body of water and the coastal currents; by these eddies sand would have been deposited (*Geogr. J.*, vol. 11, p. 641), and spits would have been formed on each side of the entrance. A longshore drift would have helped such a formation (*Geogr. J.*, vol. 11, p. 541).

A study of the tides at this part of the coast has shown that a current runs along the shore from Porthleven to Gunwalloe as the tide is coming to its flood, but that there is no appreciable current in the opposite direction during the ebb. The data upon which this statement is based may be set out in further detail. (This information has been given to the present writer verbally by the Harbour Master at Penzance, by the Coastguard Officer at Porthleven, and by local fishermen. The Admiralty charts have also been consulted, but these are on such a small scale that they have only a general, rather than a detailed,

value in this investigation.) In the offing beyond a line joining Lizard Head and Tol-Pedn-Penwith, the tidal stream runs towards the latter from about two hours before low water in Mount's Bay to about two hours after low water. It runs towards the Lizard between corresponding times before and after high water. In the intermediate periods it is setting into Mount's Bay when coming to the flood and out of the bay when going to the ebb. Its velocity is from $1^{1}/_{2}$ to 3 knots. In the immediate vicinity of the Bar Sands the effect is that, at the first part of the flood, the local stream is flowing north. It changes in such a way that, at half-flood, it is flowing east, and, at full flood, south-east, *i.e.* along the coast from Porthleven to Gunwalloe. Then it veers to south, and at quarter-ebb is going south-west. At half-ebb it is flowing west-south-west, and at full-ebb west. This means that during the whole of the ebb it is setting off-shore, so that there is practically no current along the sands at this time. The effect of the complete cycle of tidal operations should therefore be that the sand and shingle are slowly being moved from Porthleven towards the Bar; under normal conditions this does actually occur.

Conditions are not regarded as being normal when a strong south-easterly wind is blowing; this makes the worst "run" in the Bay and brings the sand and shingle back to the Porthleven end of the beach. A good deal of this may come from below low-water mark, for, on the Gunwalloe side of Porthleven, the shingle of the Bar Sands continues to slope outwards a mile or more under the sea; incidentally, this makes bathing particularly dangerous on this beach; the shingle gives under a man's weight and the undertow shifts it at once, so that the bather cannot get a firm foothold. The incessant changes in the position of the shingle were exemplified on a larger scale in 1906, when salvage operations were being conducted on the wreck of the *Anson*, a warship which came ashore a hundred years before. The shifting was such that at one moment the deck was bare and the guns were visible, only to be completely reburied in a very short time beneath the gravel ('Victoria History of Cornwall,' vol. i, p. 6). On the Rinsey side of Porthleven however the bottom is bare rock; one consequence is that ships which have to anchor in the vicinity of Porthleven do so on the Gunwalloe side.

We may now take the theory of the formation of the Loe Bar a step further. After a spit, or perhaps two, had been developed the entrance may have been closed completely either by gradual processes or by a tidal wave or by sudden storms, such as silted up the entrance to the Rother at New Romney in the thirteenth century (*Geogr. J.*, vol. 9, p. 545). In this connection it is of the greatest importance to refer to the complete alteration in the configuration of the Loe Bar in January 1924. This was brought about by what was entered in the Coastguards' "log" at the time as a "tidal wave." It was preceded and followed neither by storms nor by violent or unusual seas; in the words of the Coastguard Officer, "it was here one moment and gone the next." (For other unusual movements of the sea, see *Transactions of the Royal Geological Society of Cornwall*, vol. vi, p. 111, and vol. vii, p. 355.) The absence of storm is also supported by the fact that no coastguard was, at that time, at the watcher's hut near the Bar; a man is sent there if the velocity of the wind is at all great. The wave did considerable damage in the neighbourhood: masses of cliff were

swept away, parts of houses at Porthleven were destroyed, and a vast quantity of sand and shingle was thrown on to and over the Bar.

The entrance to the Helston haven having been closed, any projecting spit, which would then be in the middle of the 2-mile beach from Porthleven to Gunwalloe, would be cut back by the currents until the shore presented a uniform front to the sea. Meanwhile the Cober and the other small streams which run into the valley would have been bringing down sediment, but not until the Bar was sufficiently large for the water inside it to be calm would the filling of the valley proceed on a large scale.

When the bank had been formed it would increase in size by marine processes. Cornish has shown (*Geogr. J.*, vol. 11, p. 534) that a suitable oscillation of the sea on a seaward slope will set shingle travelling shorewards and sand simultaneously travelling seawards. The wash of the waves, owing to percolation, piles up the pebbles thrown forward by the breakers and forms a bank. This goes on until the wash can reach no higher, and the shingle *Full* is obtained. This stage has probably almost been reached in the case of the Loe Bar, where the top of the ridge is well above the high-water mark of the highest spring tide. Very occasionally, when a strong southerly or south-easterly gale coincides with spring tides, a storm will throw a few of the biggest waves on the top of the ridge. The water sinks so rapidly into the loose material that it reaches the fresh water only on the rarest occasions; its most advanced position is marked for some days by the wrack thrown up by it. Under such circumstances shingle may be removed from the seaward face of the Bar and flung on the top. Before the Bar reached its present height, this process probably went on during every storm, the barrier being thus increased in height and pushed shorewards. This kind of movement takes place in many localities. Where however there is a cliff or wall behind the shingle, the beach may be swept away by the backwash from the wall. This helps to explain why the material at the Porthleven end of the beach is gradually being removed; sixty years ago, according to the old inhabitants of the place, it was 15 feet higher than the bare rocks are at present; probably the material so removed has been deposited on the Bar, which is the only part of the 2-mile stretch which is free to move shorewards.

It remains to consider the historical evidence for the growth and movement of the Loe Bar. At an Eyre held in Cornwall in the year 1302 it was stated[1] that William of Trevelle held a Cornish acre of land at Degibna and Eglosderry *per seriaunciam inveniendi vnum batellum et rethia ad piscandum in lacu de Hellestona*, "by the serjeanty of supplying a boat and nets for fishing in the lake of Helston," for the King's use, whenever he visited the locality. At the same time it was recorded[2] that the burgesses of Helston exercised jurisdiction over ships anchored at Gweek, but no mention was made of ships at Helston. Gweek was 3 miles distant and served as the port of the borough; it was there that the burgesses maintained their gallows. Without interpreting the word "lake" in its strictest sense, we may conclude that in 1302 the Loe was inacces-

[1] Assize Roll 117 (at Public Record Office), mem. 44.

[2] *Ibid.*, mem. 49*d*. This is also mentioned on an Exemplification preserved among the Helston Borough Records.

sible to seagoing ships, whose entry was probably prevented by some kind of bar.

Two centuries later the Bar was so large that it gave way only once in three or four years. This we learn from Leland, who wrote[1] in the reign of King Henry VIII:

> *Lo Poole* is a 2. Miles in lenght, and betwixt it and the Mayn Se is but a Barre of Sand. And ons in 3. or 4. Yeres, what by the wait of the fresch Water and Rage of the Se, it brekith out, and then the fresch and salt Water metyng makith a wonderful Noise. But sone after the Mouth is barrid again with Sande. At other Tymes the superfluite of the Water of *Lo Poole* drenith out thorough the Sandy Barre into the Se.
>
> If this Barre might be alway kept open it wold be a goodly Haven up to *Hailestoun*.
>
> The Commune Fisch of this Pole is Trout and Ele.

Leland furnishes evidence also that early in the sixteenth century it was sometimes necessary to cut the Bar artificially. He says[2] of the Cober, calling it merely "a Ryver," that it

> yssueth toward the Sowthe See, stopped ther with Sowth Est[3] Wyndes casting up Sandes maketh a Poole cawled *Loo* of an Arow Shot yn Breede, and a ii. Myle yn Cumpas yn the Somer. In the Wynter, by the reason of Fluddes floweng to *Heylston* Town, whereby the Mylles nere *Heylston* beyng stopped Men be constrayned to cut the Sandy Banke betwyxt the Mowth of the Poole and the Se, whereby the Water may have Yssue, and the Mylles grynd; by the which Gut so opened the Se floweth and ebbeth yn to the Poole wherby Se Fysch enteryng with a Sowth Est Wynde ys closed yn the Poole, the Gut beyng agayn choked and fylled with Sand, and so after taken with Trowtes and Eles drawen yn the same Poole.

When Norden visited Cornwall half a century later he may not have seen the breaking of the Bar; he contents himself with the statement[4] that the water made "a kynde of issue":

> Low or Loo poole. A veire large water, lying in forme like a buckes horne, hauinge no entrance into the sea but bard by a banck of sande, throwgh which it maketh a kynde of issue. In this poole are great store of a kynde of trowte[5] farr excedinge the freshe water trowte in bignes and goodnes; and some other kyndes of fishe.

In 1602 Carew declared ('Survey of Cornwall,' p. 152) that the Bar was not a permanent barrier:

[1] Leland's 'Itinerary' (edited by Hearne, second edition, 1745), vol. iii, pp. 11–12.

[2] *Ibid.*, vol. vii, p. 110. This is an extract from Leland's 'Collectanea' of which a few pages were printed by Hearne as an Appendix to the seventh volume of the 'Itinerary.'

[3] Borlase ('Natural History of Cornwall,' 1758, p. 50) says, "South West winds, not the South East, as Leland says." Borlase is however wrong and Leland right; see p. 43, above.

[4] Norden probably visited Cornwall in 1584, but did not write his manuscript until 1610 ('Dict. Nat. Biog.,' xli, 106). The manuscript is preserved in the British Museum (Harl. MS. 6252); it was printed in 1728.

[5] These trout have been described in detail by Borlase in his 'Natural History of Cornwall,' p. 263, where there is also a drawing of one of them.

> Under it (*i.e.*, Helston) runneth the river Lo, whose passage into the sea is thwarted by a sandy banke which forceth the same to quurt back a great way and so make a poole of some miles in compasse. . . . The foreremembered bank serveth as a bridge to deliver wayfarers with a compendious passage to the other side; howbeit, sometimes with more haste than good speed: for, now and then, it is so pressed on the inside, with the increasing rivers waight, and a portion of the utter sand, so washed downe by the waves, that, at a sudden, out breaketh the upper part of the poole and away goeth a great deal of the sand, water and fish: which instant, if it take any passenger tardy, shrewdly endangereth him, to flit for company: and some have so miscarried.

In Leland's time the Bar gave way once "in 3. or 4. Yeres," in Carew's "now and then." We must not read into these statements a scientific accuracy unintended by the writers; it is highly probable nevertheless that the occasions of the spontaneous breaking of the barrier were fewer in Carew's time than in Leland's. The next two hundred years are a blank, as far as direct evidence is concerned. Speed's map,[1] published in 1676, shows no barrier of any kind, but calls the haven "The Lowe." The same is true of Tindal's plate,[2] published in 1732, save that the haven is called "Loe Pool." It might be argued that the use of the word "Pool" implies a barrier, but this would not be a valid deduction, since the same word is sometimes used elsewhere for water open to the sea, as in the name "The Pool of London." On the other hand, Thomas Martyn's 'New and Accurate Map of the County of Cornwall, from an Actual Survey,'[3] published in 1784, shows the "Lo Pond" and calls the entrance "The Loe Barr." In 1758 Borlase described (*loc. cit.*, p. 50) the Loe Pool and Bar, and made no mention of the latter breaking spontaneously.

When we come to the early part of the nineteenth century however we learn from Cunnack that "the water used to accumulate in the Loe, principally through the sea running over the Bar during gales," and that "the custom, when this occurred, was to obtain leave from the lord of Penrose to cut through the Bar"; spontaneous outbreaks appear to have ceased, since no mention is made of them. The memory of the oldest inhabitants in the district may be regarded as extending to about the year 1850; they have no recollection whatsoever of an outlet having been made by natural forces; nor have they heard their fathers or grandfathers speak of such a thing, and this may be regarded as evidence back to the beginning of the nineteenth century.

There is little doubt that these phenomena ceased at some time between the years 1600 and 1800, and this view is strengthened by a consideration of the rearrangement of the material of the Bar within the memory of the old inhabitants, say from 1850 to 1923—the latter date being chosen to emphasize the gradual, though not slow, nature of the change, as contrasted with the sudden and drastic alteration in the configuration of the barrier in January 1924. At the beginning of the period the Bar was much flatter than it was at the end, and, in common with the whole beach from Porthleven to Gunwalloe, extended

[1] Speed, 'The Theatre of the Empire of Great Britain,' p. 21.

[2] 'Tindal's plates to illustrate his translation of Rapin's 'History of England,' "Chart of St. George's Channel and the Irish Sea."

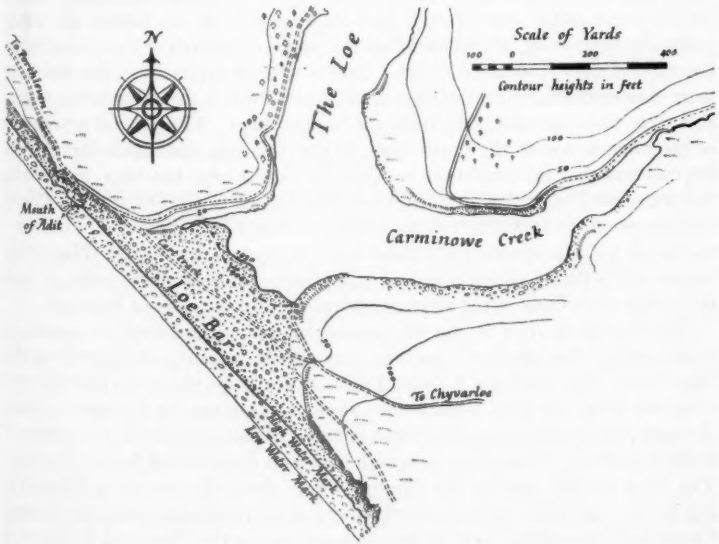
[3] A copy hangs in the museum of the Royal Geological Society of Cornwall at Penzance. There is also a copy in the rooms of the Royal Institution of Cornwall at Truro.

much farther seaward. Considerably later than 1850 the north-east, or land, side of the Bar extended no farther than the foot of the road from Chyvarloe, down which people brought their barrels and filled them with water, without having to traverse the shingle.[1] The 6-inch Ordnance Map[2] of 1908 shows the barrier a long way beyond this road. At the same time it has increased very greatly in height; it furnishes a good illustration of the laws enunciated by Cornish. Looking at the facts as a whole, and having regard to the steepness of the slopes of the cliff at various places round the Pool, particularly at points exposed to storms, there seems to be little doubt that the Loe was formerly open to the sea, that the Bar has been steadily increasing in height, and that it has been continuously encroaching upon the lake.

It is interesting to compare this with the rapid growth (*Geogr. J.*, vol. 28, p. 493) of Spurn Head in Yorkshire. In 1660 the high-water mark extended just to the south of Kilnsea, Spurn being simply a heap of shingle, some distance to the south. On a chart dated 1684 Spurn is shown connected to the mainland, but this may be incorrect, as later surveys showed Spurn to be still an island. From 1820 to 1852 Spurn was an island only at high water, but in the last-named year (1852) high-water spring tides submerged only two places. Since 1852 Spurn has been well protected by groynes and is gradually extending to the south and west. Between 1851 and 1888 it grew at the rate of 8 feet per annum on the east side and at 17 feet per annum on the west side. The growth of the Loe Bar is by no means as rapid as this, but it is perfectly certain that movement is taking place.

[1] The writer gratefully acknowledges the help he has received from Mr. W. J. Winn, formerly Borough Engineer and Surveyor of Helston, and from others in the course of conversation.

[2] Second edition; surveyed in 1906.



THE LUWATO LAGOON FLATS

VERNON BRELSFORD

DURING the months of February and March 1932 I had occasion to spend about five weeks in that area of the Kafue river flats, in Northern Rhodesia, that lies to the north of the Luwato Lagoon, and which has the Nangoma river as a western boundary. The object of my visit was locust investigation and destruction, and I had as companion Mr. J. Ker, a Government locust officer.

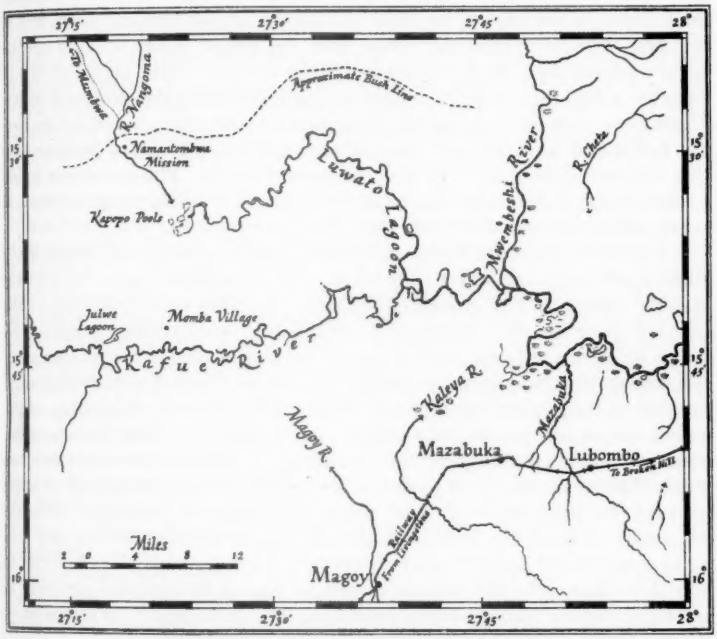
Within the area shown by the accompanying small map the flats extend in treeless waste for about 15 miles from the banks of the Kafue. The bush country ends suddenly, and it is possible to mark a definite bush-line, which, broken only by a few promontories of trees, shows where bush country ends and the plains begin. Our permanent camp was situated several miles east of Namantombwa Mission. During the dry season it is possible to tour almost all the Kafue flats by car, so unbroken is the surface. Lion, leopard, buffalo, zebra and numerous species of buck are found in great numbers, and occasional hunting parties visit the district. During 1931 the flats had become a breeding place for the red-winged variety of locust, and huge swarms began to hatch out with the rains of November and December of that year, but owing to the lack of intelligence on the part of the natives living on the edge of the flats these were not reported until January 1932.

By February the whole of the flats was waterlogged, the depth of water varying from ankle deep to chest high, and as one approached the flooded lagoon, deeper still. When we reached the bush-line we found that the rising water was driving the locusts into bush country away from the plains. The swarms round Namantombwa Mission were now in an early flying stage, and when disturbed would fly for half a mile or more before settling again. As we left the bush and plunged farther into the flats towards the lagoon, the water gradually deepening, we noticed that the stages of growth of the locusts were correspondingly immature. Those insects several miles from the tree-line were clustered thickly on bunches of tall grasses which stood out of the water, and were only just emerging from the hopper stage. The general movement of the swarms was to the north-west, so that the only reasonable explanation for this was that the southernmost swarms were a later hatching, hatched in the water itself, and reaching the surface by means of the tall grasses. Could we have obtained sufficient canoes we might have done a great deal of destructive work with sprays amongst these hoppers, but as the nearest village with canoes was a Batwa village about 15 miles away and isolated by water, we had to confine our efforts to the swarms emerging from the edge of the water.

The Nangoma river in the dry season has no water except in occasional pools, and its bed shallows and becomes almost indistinguishable along the flats 6 or 7 miles from the Kapopo Pools. Some maps show this river as running dry along the flats, while others show it as joining the Luwato Lagoon. Actually, its course in the dry season is only just distinguishable by a series of shallow dambos, or depressions, which become a definite bed during the rains. The river usually reaches the Kapopo Pools about the month of February, but in 1931 the rains were excessively heavy, and a confluence was made during December; crocodiles from the lagoon were seen in the Nangoma during that

month. On the water-covered flats crocodiles are to be found during the latter part of the rains, and although we did not see any on the flats when working or trekking in the knee-deep water, we took care always to remain close together in case any of the party were attacked.

Luwato Lagoon is a backwater of the Kafue river. It is a series of pools, whose size varies with the season, but in the early rains, about December, some of them are nearly a mile long and about 100 yards wide. These pools are linked together by streams, and the whole backwater joins the Kafue at its eastern end. At its western end, during the dry season, the lagoon ends in a number of pools, of varying sizes, known as the Kapopo Pools, which, during the months of August and September, are used as watering-places for the



cattle of the Basala people who live along the bush-line. Temporary huts, later destroyed by the floods, are erected for the people guarding the cattle. When the Nangoma reaches the Pools, during January or February, the whole area round the confluence becomes flooded, and unites with the already flooding Kafue river. Most of the country enclosed by the Luwato Lagoon and the Kafue becomes covered with water, and the game is forced into concentrated masses nearer to the bush-line.

During the dry season this enclosed area is a treeless plain, abounding in game, but inhabited by only one village under Headman Momba. The people are of the Batwa tribe, a river people, living during the flood season in a raised earth-and-pile village, although when the water recedes they build huts on the

ground on the banks of the Kafue. They do no cultivating worth speaking of, but live on fish, and spend as much of their lives in their canoes as on dry land.

Along the whole length of the flooded flats we found islands of higher ground which were used as a refuge for buffalo and an occasional lion, but the number of *lechwe*, a water buck, made a magnificent sight. We had previously heard the natives say that when the flats were flooded it was possible to see a solid mass of lechwe, miles in length, standing grazing in the very shallow water, but we had put this down as an exaggeration. However on our first arrival at the tree-line we saw, about a mile away, a long line several miles in length, of thickly herded lechwe, interspersed with a few head of zebra. The buck were so close together that we could distinguish no spaces between individual members. The rising water had driven them all into a compact mass closer to the edge of the flats. We shot a few for carriers' meat, but at our first shots they stampeded away into the deeper water, kicking up the spray and making a noise like sea rollers on a beach. They kept well out of sight for a day, then began to trickle gradually back into the shallower water. During the period we remained in the district, the water continued to rise, the Kafue still being in spate and the rains showing no sign of lessening, so that the bush-line almost became the water-line too. The game was being pushed still farther towards the bush, and lions were killing many lechwe and zebra, whose very number made them easy prey.

Towards the middle of March most of the locusts were in an advanced flying stage, and huge swarms were daily taking to the air and making off in a north-easterly direction. The grasses in the water for miles round the edge of the tree-line were deserted, although further hopper swarms were reported by scouts whom we had sent to the Kafue. It was impossible to reach these other swarms carrying our pumps and supplies of poison. We had already destroyed millions of the insects, but in their maturer stage we could only spray in the early morning and just before sundown, when the locusts were in a comatose condition; during the middle of the day they took to the air when we approached them. The smallness of our party and the difficult conditions attendant upon working in waterlogged ground made any extensive campaign difficult. Moreover our work was necessarily slow because it was essential that any area we sprayed should be kept under observation for at least two days in order to note any effect. The dry patches of ground had to be explored carefully to ascertain whether any egg deposits had been left; and a search for parasites on the locusts themselves took up no small part of our time.

However it was decided at the end of March that the few small flying swarms left on the flats could not be dealt with by our party; we therefore returned to Mumbwa, the administrative centre of the district. The portion of the Kafue flats I have described is visited occasionally by officials during the dry season, but as will be gathered from the above description, the rainy season completely alters the appearance of the country, and it is worthy of more study during the wet months of the year. The teeming game life becomes more concentrated and therefore more easy to study, whilst the birds, in their variety and number, make this district one of the most interesting portions of the Kafue valley. The bare wilderness of the dry season seems to become crowded with life during the rains.

THE BOOK OF THE MOUNT EVEREST FLIGHT

FIRST OVER EVEREST: the Houston-Mount Everest Expedition 1933. By Air-Commodore P. F. M. FELLOWES, L. V. STEWART BLACKER, Colonel P. T. ETHERTON, and Squadron-Leader the MARQUESS OF DOUGLAS AND CLYDESDALE, . . . and an account of the filming of the flight, by GEOFFREY BARKAS. *London: John Lane* 1933. $9\frac{1}{2} \times 6$ *inches;* xx + 280 *pages; illustrations and maps.* 12*s* 6*d*

IN his Foreword to this book Mr. John Buchan, who is one of the Everest Flight Committee, proposes to make it clear that the purpose of the flight "was not to perform a feat of daring or endurance, to break a record, or do something for the first time. . . . The true purpose was austerely scientific: to show that the aeroplane and the air camera could be made the means of acquiring important knowledge which would otherwise be unobtainable." But circumstances have a little changed this austere purpose. What was promoted as The 1932 British Flight to Mount Everest became The Houston-Mount Everest Flight, and is now in the book's sub-title The Houston-Mount Everest Expedition 1933, while the element of rivalry is inevitably suggested by the triumphant title 'First over Everest,' and the newer orientation of ideas gallantly shown by the frontispiece.

Early in the year 1932 Major Blacker had submitted to our Society a plan "to reconnoitre and to map by air photographs the almost unknown southern slopes of the massif of Mount Everest," and after careful inquiry the Council had expressed to the Secretary of State for India their opinion that in the event of Major Blacker being accorded permission to fly over Mount Everest, results of scientific importance were likely to be obtained. The authors of the book lay full stress upon the value of this assurance as a first step towards official approval of their project, and are justified in claiming that the support which our Council then gave to the enterprise has been vindicated by the results. The hitherto almost unknown country to the south of Mount Everest has been reconnoitred and a part of it has been provisionally mapped. The photographs and identifications which were published in the *Journal* for July last gave the first results of the reconnaissance. At the Afternoon Meeting of the Society in December Mr. Salt described the plotting of the verticals made on the second flight. And that very much more can be extracted from the oblique photographs will appear in due time.

The greater, then, must be our regret that the perspective is somewhat distorted in the picture which the authors have drawn for the public presentation of their achievement in flying over Mount Everest. "In 1932," they write, "that awesome crest was still the last stronghold of Nature, her last donjon-keep into which man had never been able to look, and her last penetralia from which he had never been able to rend the veil," the truth being that in 1924 the third Mount Everest Expedition had reached within 1000 feet of the summit; that Mount Everest, at least on its northern face, was much better known than any major peak in the Himalaya except perhaps Kangchenjunga; and that there are hundreds of miles of the great range and dozens of first-class peaks that are not yet known at all. Political objections had hitherto prevented any approach to Mount Everest from the south. These objections had happily been so far relaxed for the Mount Everest Flight that permission was given for one, and eventually for a second flight, under severe restrictions of route. One may recognize to the full the enlightened liberality of the Nepal Government in relaxing so far, and yet deplore the tragic waste of opportunity for a really great

advance in our knowledge, which the Mount Everest Flight with its skilled personnel and fine equipment might have made if they had been allowed more liberty and more time.

Their photographic results were of three kinds: verticals, obliques, and movies. The last have not yet been produced; how far topographical results may be deduced from the small pictures has not yet been examined in detail. The oblique pictures, many of them very fine, have been widely exhibited and published. Some of the best are included in the book, but almost without comment, and with small use of the identifications available. On the other hand the fine picture facing p. 194 and labelled "one of the great declivities of Everest" has never been identified as such. Without the obliques the pictorial value of the flight would have been little, for verticals of high mountain country are mere puzzles until they are viewed in pairs with a stereoscope. Without the obliques we should have learned only the detail of a strip or two, but nothing of the general aspect of the southern face; and in the obliques there is stored away a great deal of topography that in course of time we shall be able to work out if the negatives are carefully preserved. Hence we cannot agree with the authors that "the geographical advantages of the obliques by themselves could only be trivial." We had hoped that the contrary was proved when we were allowed to publish a good selection of them with careful identifications in the July *Journal*. The gloomy opinion may however have been consoling when the observers realized that the Westland machines gave a very poor field of view for the oblique cameras. It was difficult on a straight course to get the desired pictures free of struts, wings, and fuselage, and the verticals demanded a straight course; nor in any case could the pilot afford to slew the machine continually and give the observer a chance to get all the pictures he desired abeam. It is therefore ungenerous to criticize the observers, as some have done, because they did not avoid interference by wings and struts. They had in fact too much to do, in very exacting conditions, and they did very well to get through so much of mutually conflicting programmes.

The most serious failure was that of the vertical cameras on the first flight. The cabled reports from Purnea admitted that something had gone wrong with them, some failure of the cameras or the operators which was not explained. The book suggests that the failure was due to unusually high dust haze, but the obliques show that this cannot be the explanation. It was the more unfortunate since on the second flight neither machine went over the summit. They had carefully worked out a course far to the west at first, so as to have less fight against the violent west wind at the greater heights; but clouds made it impossible to observe the drift, which was greater than they allowed for, and instead of coming in from the south-west over Namche Bazar they came in from nearly due south just west of Chamlang—one should read "eastward" instead of "westward" in the middle of p. 213—and the vertical strip could not be placed until some detail was identified with detail on an oblique of that mountain. How small was this product of so large and expensive an effort is shown without comment in the diagram inserted opposite p. 219, which has the air of being an afterthought, since it is not included in the list of illustrations.

The authors have left it to Mr. Buchan in his Foreword to assess the result of their enterprise, and he puts it thus:

> The difficulty of taking photographs at such an altitude will be made clear in the succeeding pages, but it is a great thing to have established that it is possible, and that we have a new and effective instrument for the survey of regions that cannot be traversed by the foot of man. It was not to be expected that the flights would reveal any startling new geographical features, but two

glaciers, hitherto unknown, have been discovered, and a small high-level lake, which may possibly be hot water.

This claims both too much and too little. That air photography is an effective instrument of surveying inaccessible country was already well known. Given the power of taking a camera to 33,000 feet, that it would work there is nothing surprising. The technique is interesting, but not revolutionary. On the other hand, the geographical features of Mount Everest's south face, now revealed, are startlingly different from those on the known faces. The thin overhanging buttressed southern wall of the western cym, the magnificent truncated spurs separated by profound couloirs, are unsurpassed. Not two new glaciers but whole fields of them behind Chamlang are now seen for the first time, but the little "hot lake" is neither so big nor anything like so high nor so near Mount Everest as was first reported. Let us repeat: the photographs taken on these two flights are of much geographical value in themselves, and not merely as a demonstration of possibilities for the future. But the full value of the negatives cannot be extracted from them at once, and a great responsibility rests upon those in whose keeping they are.

Those chapters in the book which deal with the actual flights are in great part a reproduction of the original messages to *The Times*. The account of the machines and the high-altitude equipment is full of technical interest, but it is not made clear how much of it is common practice and how much is novel. The two long chapters on the early history of the mountain and the exploration of Tibet are ancient matter extracted from the Records and Reports of the Survey of India, and a little out of scale; they do scant justice to the explorations of the first Mount Everest Expedition. There are some passages which will jar upon the mountaineer and some upon the surveyor, a little fulsomeness, and occasional extravagances of statement; but these do not much detract from the story of a great adventure, well planned and boldly carried through. The book is well produced at a very reasonable price, has many excellent illustrations, and an amusing anaglyph from a pair of verticals, with the necessary green and red spectacles in a pocket at the end.

REVIEWS

EUROPE

THE BRITISH ISLES: a geographic and economic survey. By L. DUDLEY STAMP and STANLEY H. BEAVER; with contributions by Sir JOSIAH STAMP and D. K. SMEE. *London: Longmans, Green and Co.* 1933. 9 × 5½ *inches;* xii + 720 *pages; maps and diagrams.* 25*s*

This is perhaps the most important work on the geography of these islands published since the War. The authors have gathered together the results of a large proportion of the many studies of smaller regions, or of particular aspects, by other students, in addition to their own investigations. The space available is fairly well distributed among the various topics; but almost every one of the thirty-five chapters would be expanded into a large volume if the survey became exhaustive.

In the opening chapter on the Position of Britain it would have been relevant to note that Britain is in the northern fringe of the habitable world, farther from the equator than any other comparably populous land; and also that the value of its position near the centre of the Land Hemisphere is diminished by the existence of the North Polar Ice, which prohibits the use of the northern routes. There are excellent concise accounts of the Physiographic Evolution and of the Natural Vegetation. The chapter on Weather and Climate is less happy. The hypothetical and "generalized" statements (Figs. 46–48) if used at all should follow the specific illustrations (Figs. 49, 50). But in fact British weather is so variable that most generalizations are unsafe; and it is better to rest interpretations on typical observed facts than on any hypothesis. We may also suggest that, for the purposes of this book, the division into climatic "quadrants" should be based on "actual" rather than on sea-level isotherms (Figs. 53–55).

The chapters on Agriculture form a section which is in itself sufficient to make the book valuable to serious readers. The brief descriptions of the numerous "agricultural regions" marked out are clear. The division into regions is based first on altitude, those of the Highlands and Lowlands respectively, and within these zones on position and surface rocks. Most geographers will agree with the division in its main lines. It may be noted that on Fig. 113 the Vale of Tees is included in region 8, *i.e.* with the Vale of York, while in the text (p. 227) it is described as part of region 5, "Northumbria." The diagram gives the truer relation. The degree of subdivision varies considerably, *e.g.* Yorkshire is in seven such regions or subregions, four of which are entirely within that shire, while region 9, "The Midlands of England," with a larger area and comparable variations of relief and soil, is not subdivided. The reading of this section is facilitated by reference to some of the diagrams given earlier; and cross references would be useful.

Chapters XV–XXIV are devoted to the industrial geography of Great Britain, taking first the mining, then the metal and textile industries, and then the many smaller industries. There is some account of the localization of each industry and of some of its units; and the survey provides many facts for a study of the problems of localization. It is a clear and straightforward description of the industries and their distribution.

The peopling of Britain, and the present distribution of its population, are dealt with in two short chapters of only fifteen pages. But "man-power" is the chief of the resources of this, or any other, country; and it deserves a fuller survey than is given to it here. The utilization of all natural resources depends

entirely on human efforts; and hence the distribution of the population, as a whole and in the chief occupational groups, is one of the most important of the facts to be considered in a complete survey of our resources.

Of the remaining chapters the one of most general interest is that on London, in which there is a tentative account of some of its various "quarters." Others deal with the Seaports and with Foreign Trade. The chapter on The Commerce and Ports of Ireland is by Dr. D. K. Smee. Most of it is taken up by careful detailed studies of the several ports; two map-diagrams (Figs. 285 and 287) mark the "hinterlands" of these ports, and in the second of these certain areas are marked as "exclusive" to the particular ports. We are not told how these hinterlands have been delimited; they appear reasonable. But any one who has attempted to investigate the facts knows how many pitfalls there are in the way of accurate delimitation, and it would be helpful to know how the difficulties have been overcome in this case.

The book is well produced, and has nearly three hundred illustrations, the majority of which are very clear diagrams. There are short lists of references at the ends of several of the chapters, and some others are given in footnotes. For a first edition misprints are rare; but "like" for "lake" in the phrase "glacial lake basins" (p. 48) may mislead the non-technical reader. The book will be indispensable to students of economic geography; and it should appeal to a wider public among those who wish to know more of this country. C. B. F.

RONAY: a description of the islands of North Rona and Sula Sgeir, together with their geography, topography, history, and natural history, etc., to which is appended a short account of the Seven Hunters, or Flannan Islands. By MALCOLM STEWART. *Oxford: University Press* 1933. 9×6 *inches;* x+74 *pages; illustrations and maps.* 7*s* 6*d*

The island of Ronay, or North Rona, lies approximately north-east of the island of Lewis and north-west of Cape Wrath.

Although this concise and well-illustrated volume deals with the facts, geographical, botanical, historical, and natural, the charm and romance of these Western Isles is also brought home to the reader. The 40-mile voyage in a trawler is only for the adventurous: "Landing was by no means easy . . . a quick jump ashore while the boat rose and a desperate grab at the rock was the only course to adopt." The island, now the home of the seabird and the seal, was formerly inhabited. "By far the most famous and interesting of the buildings on North Rona is the chapel, . . . which Muir claims to be eighth or ninth century." The legends of the island are also given, and two chapters deal with Sula Sgeir and the sinister Flannan Islands. There are at the end of the book three maps of these little-known islands. A. Mc. C.

OUR FOREFATHERS, THE GOTHONIC NATIONS. By GUDMUND SCHÜTTE. Volume II. *Cambridge: University Press* 1933. 9½×6½ *inches;* xvi+482+20 *pages; maps.* 30*s*

In this second volume the author describes and elaborates in detail the ethnology and early history of the sub-groups of the Gothonic group of peoples dealt with generally in the first which was reviewed in the *Journal* (vol. 74, p. 594). To do this adequately requires prodigious knowledge and research, and as Dr. Schütte observes in his preface, can be satisfactorily achieved only by the various parts being worked out by as many separate experts. Being unable to obtain this collaboration he has been thrown on his own resources save for the friendly revision of some chapters. The learning, industry, and research with which he has tackled his laborious task are manifest throughout the book and entitle him

to hope that his attempt to create the first Anglo-Saxon manual of Gothonic Ethnology may soon lead to the publication of a co-operative manual on the scale of the great encyclopaedias.

Dr. Schütte classifies the Gothonic nations in a number of sub-groups, the chief of which are the East Gothonic, the German-Dutch or South Gothonic, the North-West Gothonic, and the Scandinavian or North Gothonic. Each of these is treated under five heads, viz. Names, Sub-divisions, Ethnic Position, History, and Legendary Traditions. The part which will more particularly appeal to the English reader is the North-West group, for it includes the Saxons, Angles, Jutes, and Frisians, and gives a critical account of the Anglo-Saxon conquest of Britain. Any detailed examination is impossible in a brief notice of such a work which might be described as the skeleton of an encyclopaedia; suffice it to say that it will be invaluable to all who may desire to enter upon the study or research of this branch of ethnology. The book is most fully documented in the text, is provided with a list of references, an index, and several maps showing the distribution of House types, English and Scandinavian dialects, the Anglo-Saxon states, the political and cultural divisions of Early England, *castra* and Anglo-Saxon burial mounds in England. E. A. P.

ÉTATS SCANDINAVES. RÉGIONS POLAIRES BORÉALES. By MAURICE ZIMMERMANN. (Géographie Universelle. Edited by P. VIDAL DE LA BLANCHE and L. GALLOIS. Tome III.) *Paris: Armand Colin* 1933. 11½×8 *inches; 310 pages; illustrations and maps. 90 fr*

The present volume of this excellent work treats of Denmark, Norway, Sweden, Iceland, the Arctic Ocean, Greenland, Spitsbergen, and other islands of the Old World Arctic. The Scandinavian chapters are naturally the fullest and they will prove the most welcome to geographers since comparatively little has so far been published in English or French on the geography of Denmark and Norway, which is full and modern in its treatment. In each country the physical basis is adequately discussed but not overstressed, and the regional treatment and economic life receive most attention. In the chapters on Denmark particular note may be made of the discussion on the changes in distribution of population since early times and the development of agriculture from the days of wheat growing and pig export to the present dairy and allied output. It would be difficult to praise too highly this section. In the chapters on Norway an instance of the author's grasp of factors of geographical significance is his treatment of the changes in the life of Nordland during the last century or his regional study of Eastern Norway. Sweden gets a fuller treatment, and even Iceland has some ten pages.

The polar regions have briefer notice. The section on the Arctic Ocean leaves unnoticed the problem regarding its age that the shallow water fossils of Arctic palaeozoic rocks suggest. In the chapter on plant life it would be well to introduce Warming's name of *fjacldmark* for the open tundra of Spitsbergen, Eastern Greenland, etc., and we miss any discussion of the physical basis of the extraordinary richness of life in the relatively ice-free polar seas. In Spitsbergen the walrus is extinct only on the west, and on Hope Island coal may exist but has not been found *in situ*. The map of Icefjord (Fig. 63) has a few mistakes in the spelling of place-names, the use of Gips Hook and the omission of the Klaas of Klaas Billen Bay, although this practice has crept into Norwegian maps. Lastly, Russia and Great Britain cannot be charged with having quarrelled over the possession of Wrangel Island, which this country never coveted. These however are minor slips. The excellence of this section is apparent in such matters as the general summary of Eskimo development and culture, and

the inclusion of Wegener's observations on the alimentation of the Greenland ice-sheet, and Ahlman's work on North-East Land. The value of the volume is enhanced by many well-chosen illustrations, and maps and adequate bibliographies. R. N. R. B.

ASIA

BOMBAY IN THE DAYS OF QUEEN ANNE: being an account of the settlement, written by JOHN BURNELL; with an introduction and notes by SAMUEL T. SHEPPARD. To which is added: Burnell's Narrative of his Adventures in Bengal; with an introduction by Sir WILLIAM FOSTER, and notes by Sir EVAN COTTON and L. M. ANSTEY. (Works issued by the Hakluyt Society. Second Series. No. LXXII. Issued for 1933.) *London: The Hakluyt Society* 1933. 9×5½ *inches;* xxx+192 *pages; maps*

The accounts reproduced in this volume are contained in the Orme MSS. in the India Office Library. Their authorship had remained a puzzle till solved by Miss Anstey a few years back. Of the writer nothing is known beyond what is to be found in the East India Company's records of the years 1710–13. He served as an ensign on the Bombay establishment in 1710–11, leaving, in May 1711, in a ship bound for England, which was driven by bad weather to put in at Madras. There he seems to have changed his mind, and was employed by the Madras Council, only to be dismissed within a year for repeated disorderly conduct. He next tried his fortune, apparently with no better success, in Bengal, whence he was given leave to proceed to England in a vessel which is known to have sailed from the mouth of the Hugli in February 1713/14. No more is heard of him: his birthplace, parentage, and further career are alike untraced. That he possessed considerable ability and the power of accurate observation is obvious from his full description of Bombay Island, its physical features, divisions, civil and military government, sites and objects of interest, products, and the customs and ceremonies of its inhabitants. No previous account gives so much topographical detail; and Mr. Sheppard is to be commended, not only for recognizing its special value, but for the great pains he has taken in editing it. The Bengal narrative is of considerably less value, and unfortunately ends abruptly, without the promised account of the tour up the Ganges "of near 300 miles" from Bandel, a journey that would have carried him to the vicinity of Pirpainti in the Bhagalpur district.

The introductions are both good, supplying just the information required to elucidate the text. The footnotes are full, yet concise. Only two points call for notice. *Murcha* (p. 20, n. 1) is a Persian word meaning a "battery" (not "cargo-boat"), used in North Indian vernaculars in the sense of a "line of entrenchment, or fortification." That the Dutch had a factory at Rajmahal (p. 149, n. 1) in 1670 at all events, is evident from the narrative of Nicholas de Graaf ('Voyages'), who mentions the Dutch factory in that year.

The insertion of a map of Bombay Island as it is to-day would have been welcome, for comparison with the "Reconstruction" of conditions in 1710 (p. 90), and to enable the reader to realize the vast changes produced by reclamation works. C. E. A. W. O.

IN ASIA'S ARMS. By Captain S. E. G. PONDER. *London: Stanley Paul & Co.* [1933]. 9×5½ *inches;* 256 *pages; illustrations and sketch-map.* 12*s* 6*d*

Captain Ponder, already a traveller of some accomplishment, dreamed of a journey through the Far East, and, his dream having at length been comprehensively realized, writes this account of his experiences so that others less fortunately placed may participate in the joy that was his. The joy however seems

to have been not quite unalloyed, for of many of the places visited the traveller records only dirt, smells, or dullness, while of his progress from place to place, sometimes through country of much interest and scenic beauty, the general impression given is one of bored irritation. But though Singapore, Batavia, Macassar, Seoul, Mukden, much of Japan, and many other localities proved to him barren of interest, the author found compensation in Bangkok, Angkor, Tosari and Bromo, Bali, Peking and its departing glories, Kalgan and the Great Wall, and in a typhoon encountered between Manila and Hongkong.

To compress a journey of 10,000 miles comprising visits to fifty or more remarkable places within a period of less than four months, and further to squeeze the account of it into a book of this size, must necessarily result in a certain perfunctoriness, but the author has some good passages on those parts of his tour that aroused his enthusiasm, which save his work from being classed as the crude record of a tourist scamper. His sentences sometimes take queer turns, as on p. 238: "he will be buried in some overgrown cemetery and soon be as if he never was." The illustrations are uniformly good, but are scattered through the book with scarcely any reference to the text. W. A. G.

HOW CHINESE FAMILIES LIVE IN PEIPING. By SIDNEY D. GAMBLE. *New York and London: Funk and Wagnalls Co.* 1933. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* xviii +348 *pages; illustrations and diagrams.* $3

The subtitle of this careful volume is 'A study of the income of 283 Chinese families receiving from $8 to $550 silver per month,' which explains the contents very adequately. The book is economic and sociological in its point of view and interest. Probably any similar study in Western Europe would hardly be noticed by any geographers except a few specialists. As however the author is dealing with a foreign environment and a foreign culture, it may have a wider geographical value, more especially since Mr. Gamble is careful to draw attention to the response of these families to their environment and its seasonal changes. A great many of the families whose income and expenditure were examined were living almost as closely as possible to the margin of subsistence, and their methods of making two ends meet are sometimes almost pathetic in their ingenuity and success. The scheme of the book covers the social position of the families examined, their income and expenditure in detail. The latter includes food, clothing (sometimes most exiguous), housing, heat, light, and water, and the disproportionately large item of weddings and funerals. Finally the details of a number of actual family budgets are given. The whole piece of research has been done with very great sympathy and care, and should prove of interest even to those whose regular studies do not include the economics of Eastern nations.

L. H. D. B.

AFRICA

SOUTH AFRICAN SUMMER: 5000 miles with a car and caravan-trailer. By DOROTHY UNA RATCLIFFE (Mrs. MCGRIGOR PHILLIPS). *London: Country Life* [1933]. $9\frac{1}{2} \times 6$ *inches;* x+190 *pages; illustrations and map.* 10*s* 6*d*

There is little serious knowledge to be gathered from this book which yields however four or five hours of pleasant reading and leaves behind the memory of vivid word pictures of scenes, creatures, and persons sketched on a journey from Cape Town to Krantz kop. It was undertaken with a husband, a sailor-cook, a caravan-trailer, and a kettle, called respectively the Laird, Hal Green, Marigold, and The Little Bear; and with ample other equipment described but not specially named. The journey lay for the most part within 50 miles of the shore of the

Indian Ocean, but west of the latitude of Mossel Bay it covered much of the country for a further 50 miles inland, and in Natal the wanderings of the car reached the north-west corner of the province, 150 miles from the sea. The travels over the western part of the Cape Colony take up half the book—the less interesting half, as dealing most with travel detail and caravan housekeeping. After coming down from Prince Alfred's Pass, what is probably the most typical though certainly not the most beautiful part of the country was traversed; then the Transkei, stated to be "the fairest part of all South Africa," Tembuland, Pondoland, Griqualand, and Natal. The fifty-five pages dealing with the journey east of the Great Kei river are the most interesting of the book. These pages contain amidst much lighter matter a few references to native African superstitions, an account of the paramount chief of Pondoland, the opinion of an educated Fingo that polygamy is a good thing for his people, some facts with regard to *lobolo* or dowry in cattle, extracts from the Bluebook of the United Transkei Territorial Council, and a good story of Sir Theophilus Shepstone and Cetewayo told to illustrate the Zulu talent of illustration.

Vivid pictures are a great feature of Miss Ratcliffe's work. They are drawn in well-chosen words—of mountain passes at night and drifts and river crossings in the morning; of a storm at the Knysna headland and of a flood in the Malpas river; of the beautiful Huguenot homestead of Dieudonné in the Drakenstein Valley; of jacarandas flowering in western Cape Colony and eastern Natal, and willows on the Mooi River; of a happy diver dipping into Gordon's Bay, thirteen tired swallows on the Onrust telephone wire, a shining sun-bird on a scarlet hibiscus bush at the foot of the Outeniqua Mountains, and a snake bird killing puff-adders by the Umtata Falls; so of other forms of animal life and so of human beings, especially dark-coloured ones in the bright raiment they love and that our author loves to describe.

Her descriptions of native women and children are charming and her kindness to them and to other beings she encounters, to which kindness her husband's gruffness as she depicts it serves as a foil, bears out the statement of her friend, Mrs. Buffey, in the opening chapter "you'd allus find summat good to say aboot everything." Possibly not strictly in accord with this is however the charge of corruption brought against Custom House Officials at Cape Town at the beginning of the book and a statement near the end that no pleasant officials were met with in the length and breadth of South Africa except one Irish man and one German girl.

Another fault of this book is on a different plane. The map omits the names of some places mentioned in the text though it contains many of those not mentioned.

M. N.

REPORT ON THE MEASUREMENT OF THE ARC OF THE thirtieth meridian in North Eastern Rhodesia. Vol. VI of the Geodetic Survey of South Africa. Edited by G. T. McCaw, with an introduction by Colonel M. N. MacLeod, D.S.O., M.C. *London: His Majesty's Stationery Office* 1933. 13×8 *inches; 124 pages; maps*

A great deal of the value and much of the charm of this Report is due to the fact that it has quite obviously been prepared by a man who thirty years previously had himself taken no small share in the field work concerned. The occasional and apparently accidental insertion of the first person plural brings vivid flashes of active participation into a report of which the interest must otherwise lie of necessity in technical channels.

It is impossible to ignore the underlying romance of this great undertaking. The very words of Cecil Rhodes, "I have promised Sir David Gill that I will

carry the Geodetic Arc of Meridian to Tanganyika. Charge it as you will—that is only a matter of red tape," speak of a Golden Age to those who are now struggling with the effects of world depression. Nor indeed is romance lacking in the picture of Dr. Rubin himself, who after the survey had closed down behind him owing to financial stringency "decided to take advantage of the six months' leave to which he was entitled in order to carry the work farther north," and who thereupon did so, paying out of his own pocket the native boys who were his sole companions.

The report consists not only of the publication in detail of the results obtained and of the methods used to obtain them, but is a practical guide for the use of surveyors who are fortunate enough to be called to undertake the continuation of this work. The completeness of the results suffers from the fact that the descriptions of the stations, for reasons which have never been satisfactorily explained, are nowhere to be found. The method of applying the limited brain power of the native to the correct working of a heliograph and the analysis of the results obtained thereby in varying conditions of visibility is of great practical interest, as too are the paragraphs devoted to the behaviour of invar and the standardization of the reference tapes, while the difficulties and irritation attendant on the use of the Russian $2^{1}/_{2}$-metre Bar are stressed by the very moderation of the language employed.

The main interest of this report however lies in the doubts that are raised by the discrepancy between the observed and computed azimuths at Msambansovu and Lavusi. This discrepancy is about 15″ at Lavusi, and it is understood that in the continuation of the work northwards by Major Hotine it is of the order of 20″. There is no reason whatever to suspect that the cause of this discrepancy need be sought in the work carried out to the south by the Union. The difference between observed and computed azimuths at Hout's River is not more than 0″.70, so that it appears that the reason must be sought either in the connection across the River Limpopo or in some deviation of the vertical farther north.

The re-observation of the Limpopo connection was strongly recommended by the Union of Geodesy and Geophysics, and will be done; it is possible that the Uganda connection will relieve the difficulty and permit of an azimuth equation northwards from Hout's River; but at the same time, although the latitude is low, the land masses of Africa are vast, and we cannot quite abolish the possibility of some deviation from the vertical. Much as we must deplore the fact that financial stringency has dictated the cessation of the measurement before the connection with Uganda has been made, this connection could not in itself have had any definite finality. There are indeed too many factors adjacent to the Uganda measurement, vast mountain masses and rift valleys, for us to feel that absolute certainty which is required for a terminal point of an arc measurement of this dimension. One is left with the impression that no satisfactory solution will be found, and indeed that it would be waste of time to seek it, until the arc has been completed and tied out strongly at its northern extremity, a consummation which at the present moment seems remote.

Sir David Gill in his original letters begging for and securing the money to undertake the observation of the arc foresaw clearly the practical as well as the theoretical value of this undertaking. The danger and expense of a series of individual surveys, unrelated either to each other or to any common backbone, has been only too often demonstrated. It is the more to be deplored that this clarity of vision has not been shown by those who have insisted on the cessation of this work at a time when the expenditure of a few thousand pounds would have enabled the men and the instruments, already on the spot, to have completed the link with the Uganda, and thus brought one great stage of this undertaking

to a conclusion. It was laid down as one of the duties of the Geographical Section of the War Office, soon after its inception, that it should encourage and advise upon Colonial Surveys. This report is a remarkable proof of the attention paid by that Section to its original terms of reference and of the Imperial services it renders thereby. J. C. T. W.

POLAR REGIONS

POLAR-ÅRBOKEN, 1933. Utgitt av Norsk Polarklubb. *Oslo: Gyldendal Norsk Forlag* 1933. 9×6 *inches; 168 pages; illustrations. Kr.5.50*

The ancient Norse interest in the Arctic that led to the discovery of Greenland, Svalbard, and other Arctic lands, has undergone a great revival in recent times. From the days of Nansen's great journeys Norwegian polar travellers have increased in numbers and widened the range of their interests around both poles. The Norwegian Polar Club was founded in Oslo in February 1933 with Dr. A. Hoel as its first president and with a membership of over a hundred. The present volume is the first annual publication of that club. In addition to news of various polar activities, mainly Norwegian, it contains about a dozen miscellaneous papers by well-known polar travellers and residents. These are of a popular or general nature, and are well illustrated by drawings and photographs. Some are reminiscent, such as The Last of the Old Guard, which records the lonely adventures of Björvig and Bentsen in Franz Josef Land, and the life of H. C. Johannesen of Nordenskiold's *Vega* Expedition. A striking document is Olsen's diary found in his winter hut at Cape Boheman, in Spitsbergen. Other articles are informative, such as O. Holtedahl's on his Nova Zemlya Expedition, W. Werenskiold's on the coalfields of Svalbard, G. Isaachsen's on polar dogs, and L. Christensen's on a whaling voyage to the Antarctic. Altogether it is a pleasant volume and reflects the wide range of Norwegian polar enterprise. R. N. R. B.

NANSEN OF NORWAY. By CHARLES TURLEY. *London: Methuen & Co.* 1933. 7½×5 *inches; 210 pages; illustrations and sketch-maps.* 5*s*

We welcome this little book as it is a simple and faithful narrative of one of the greatest men of his time. We hope that its low price and attractive appearance have made it a favourite Christmas book for young people who would certainly enjoy the story of adventure and sport and might possibly be stirred to emulate the virtues of the hero.

The author frankly disclaims originality of any kind. The book is put together from published works with no extraneous merits of presentation or style. However it is conscientious and accurate, save perhaps for a few minor lapses such as the spelling of names on pp. 160 and 163. Its appeal is not sensational but lies in the plain recital of intensely interesting facts and the clear statement of the guiding principles which made Nansen's life a continuous realization of his idea of going forward always and never troubling about a line of retreat. We miss indeed the sense of that personal magnetism which made the subject of the book not so much "Nansen of Norway" as Nansen the fellow citizen of all peoples, and fitted him to fill a part in repairing the damages of the Great War that no other man could have attempted.

As four-fifths of the space is given to the record of exploration in the first half of Nansen's life we are sorry that the two portraits represent him as a man worn with responsibility and thought, though the drawing on the dust-cover does give a faint hint of his splendid bearing when in the pride of his youth.

H. R. M.

EDWARD WILSON OF THE ANTARCTIC. By GEORGE SEAVER. *London: John Murray* 1933. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* xxxiv + 300 *pages; illustrations and maps.* 10*s* 6*d*

There is more literature about Scott's last expedition than about any other Polar venture, and there is a good deal about his first as well. In all these books Dr. Wilson appears as the personal friend and counsellor of every member of the party and as the leader's right-hand man. The peculiar value of this book is that it helps us to appreciate how Wilson achieved, largely by conscious effort, a state of mind which won confidence so naturally.

The description begins at Cheltenham where already his spare hours were his busiest, for he was studying birds—a pursuit which encourages thought—and teaching himself to draw. Then in the same spirit that "here we have no abiding place," that every act was a preparation for something more important, he went through life at Cambridge and at a London hospital. This was followed by a physical breakdown and an arduous rest cure in Norway and Switzerland.

When his chance came to go with Scott's first Antarctic Expedition he was diffident to take it—he had confidence in his own ability to work but mistrusted his physique and the sufficiency of his knowledge—until he realized that by the sequence of events he would go without asking to and almost inevitably. Once these private doubts were settled he threw himself whole-heartedly into the work of preparation. The pages about the expedition, which are derived from Wilson's letters and diary entries, are mainly descriptive of his mental life.

Back in England he joined the commission which was studying the causes of Grouse disease. He took his responsibility in this work so seriously that he did not feel justified in accepting Shackleton's urgent invitation to go south again before it was finished. In such spare time as he had he was keeping in touch with his friends, illustrating a book on British mammals and adding to his own bird pictures. Finally there is the description of Scott's last expedition and, in the Polar journey, of Wilson's achievement of his own "most fascinating ideal ... to become entirely careless of your own soul or body in looking after the welfare of others."

Such is the story. Of the characteristics which appear one can mention only a few: Wilson's ascetic mysticism which in no way narrowed his appreciation of real humour; his fearless criticism of others and still sterner criticism of himself; his strength of mind which carried him on even when his body failed; his determination, strengthened after marriage, to give his best to everything he did; the value which he set upon his friendships; his honesty; his fatalism; and yet his carefulness in preparation, are the most striking. But such a catalogue becomes a eulogy, which the book is not. It aims at undecorated description and its value is that it succeeds. J. M. S.

THE EPIC OF CAPTAIN SCOTT. By MARTIN LINDSAY. [*London*]: *Peter Davies* 1933. 8×5 *inches;* 178 *pages; illustrations and sketch-maps.* 5*s*

"Great Occasions" is the title of the series to which this volume belongs. Scott's last journey was indeed a great occasion though Mr. Lindsay is too young to know from his own experience how strangely and how deeply it appealed to the world of 1913 still unconscious of the hidden reserves of heroism which the Great War revealed. The author has however been guided by those most intimately associated with the tension at home and the struggle on the Antarctic ice, for his proofs have been read by Lady Hilton Young, Captain Scott's widow, and assistance given by Mr. Cherry-Garrard, a member of the supporting party which returned from the Beardmore Glacier and the writer of the most powerful and convincing narrative of the epic adventure.

Thus guided Mr. Lindsay has described briefly but with dignity and restraint the well-known incidents of Scott's resolute march to the South Pole and of his terrible return journey to the last camp. It is a noble story in its human aspects, and with these alone it deals. Mr. Cherry-Garrard, Mr. Gordon Hayes, and Dr. Simpson have tried to analyse the causes of the final disaster in their published works, but no new light is thrown upon it here. While the main theme of the book is well handled the same cannot be said for the introductory portion which occupies about one-fifth of the space. It consists of a sketch of Antarctic exploration before the twentieth century and a summary of the work of Scott on the *Discovery* expedition.

Extreme compression may account for some statements appearing to suggest errors, such as "the magnetic pole was looked for in the interior" of Victoria Land by Ross (p. 24), whereas of course Ross never landed on the continent. The account of the *Discovery* expedition contains loose statements such as that on p. 31 regarding life in polar conditions of which "everybody was equally ignorant." This was not so, for Bernacchi had been on the *Southern Cross* and had landed on the Barrier, while both Armitage, the second in command, and Koettlitz had spent three strenuous years in Franz Josef Land. It was Armitage also who first found the way across the Western Mountains and made an extensive journey on the Plateau of Victoria Land, a fact which is not referred to in the note on p. 34, on Scott's subsequent and much longer Plateau journey.

It is unfortunate that Mr. Lindsay should repeat (on p. 33) the unfounded story that when Shackleton broke down on the return to the *Discovery* in 1903 he was for a time dragged on the sledge by Scott and Wilson. Willing as his comrades would have been to spend the last ounce of their strength to save their friend, Shackleton would rather have died than allow them to do so, and he succeeded in walking beside the sledge all the time after he was unable any longer to pull. Scott stated this in a letter to the newspaper which first printed the fable. The first great discovery made by Scott is not mentioned at all. This was the non-existence of Ross's McMurdo Bay which was found to be the opening of a broad channel. Indeed Ross is here credited (p. 23) with having seen and named McMurdo Sound. Haste in production may possibly account for these errors and for such mis-spellings as Bellinghausen (p. 22) and the Bay of Wales (p. 41).

H. R. M.

PHYSICAL AND BIOLOGICAL GEOGRAPHY

HISTORICAL GEOLOGY. By RAYMOND C. MOORE. *New York and London: McGraw-Hill Book Company* 1933. 9×6 *inches;* xiv+674 *pages; illustrations and maps.* 24*s*

A TEXTBOOK OF GEOLOGY. Part II. Historical Geology. By CHARLES SCHUCHERT and CARL O. DUNBAR. Third Edition Largely rewritten. *New York: John Wiley & Sons; London: Chapman & Hall* 1933. 9×6 *inches;* viii+552 *pages; illustrations and maps.* 25*s*

The common title of these two works is significant. The great advance in geological synthesis which marks the last forty years is transforming Stratigraphy into Historical Geology. It is now becoming possible to give a connected account of the geographical and biological development of each of the great continents, except in so far as any one of them may be insufficiently explored. If this cannot yet be done for the whole Earth, it is because of the sharp divisions of opinion as to the permanence or impermanence of oceans and continents and the fixity or mobility of the latter. The authors of both the works before us confine themselves almost entirely to the historical geology of North America, references to

other continents being (especially in Professor Moore's book) very slight. This is no matter for complaint. British authors have often written the story of the Earth as though it were mainly a matter of our far smaller area, and North America is a much better sample of the whole world.

The general method of each book is the same: it might be described as a connected story of the Earth (as illustrated mainly by North America) with a running commentary on the evidence. Professor Moore chooses the Grand Canyon of the Colorado as a concrete example on a large scale of the evidence upon which historical geology is built up, and gives a detailed description of this wonderful section as an interlude between the early chapters on the origin and fundamental structure of the Earth and the later chapters dealing with the records of the rocks. In these later chapters he treats the history of life apart from that of the inorganic earth, summarizing the palaeontology at the end of each great era only. We notice one curious mistake in Fig. 122, where what is obviously a restoration of the extinct belemnite is stated to be a modern squid.

Professors Schuchert and Dunbar weave their palaeontology more into the texture of their history. Their introductory chapters deal with the conditions of preservation of fossils and the evidences of evolution, and an appendix is devoted to the classification of animals and plants. There is a slip on p. 450, where the colossal rhinoceros *Baluchitherium* is given a Pliocene (instead of an Oligocene-Miocene) age.

Both works can be recommended to all who wish to learn the most modern conclusions about the geological history of North America (and, to some extent, of the world). Choice between them will be largely determined by the reader's feeling towards palaeontology. Those who wish for guidance on the questions of the permanence and mobility of continents will be disappointed, the discussion being of a very summary kind in both. A. M. D.

DIE PERMOKARBONISCHEN EISZEITEN. By W. SALOMON-CALVI. *Leipzig: Akademische Verlagsgesellschaft* 1933. 9×6 *inches;* viii+156 *pages; sketch-maps.* *M.*13.80

In this monograph the author brings together all the evidence for the character and extent of the Permo-carboniferous glaciations. Large areas in Africa, India, Australia, and South America are involved, totalling something approaching 14 million square kilometres, which were covered by inland-ice masses, not by mountain glaciers. To explain one such Permo-carboniferous glaciation, he groups the southern continents around the South Pole, and calls in an "Epeirophorese"—seemingly a variation of Wegener's continental drift which does not imply continued westward movement—to bring about the present land distribution. Other points in his argument are the lack of evidence for the glaciation of the present Antarctic continent long before the Diluvial, and the migration of the Glossopteris flora, regarded as a normal carboniferous flora, from the present Antarctic to his "southern continent." G. R. C.

CARTOGRAPHY

MAPS AND SURVEY. By ARTHUR R. HINKS. Third edition. *Cambridge: University Press* 1933. 9×5½ *inches;* xii+284 *pages; illustrations, diagrams, and facsimile maps.* 12*s* 6*d*

Three editions of this excellent introduction to the study of surveying and cartography have succeeded each other at intervals of ten years; for the first was published in 1913, the second in 1923, and the third this year. And these editions reflect the character of the changes which the art of map-making has

undergone during the past twenty years. The author remarks in his Preface that "the second edition was . . . transitional from the pre-war subject" to the considerably altered practice of the present day, and that the third edition has been largely rewritten. In particular, somewhat more space has been devoted to a sketch of Air Survey methods, which, of course, have now a considerable literature of their own; and the twenty-five-page chapter on Geodesy has been recast and the discussion on Stereographic Survey much extended.

The chapter on Geodetic Survey is particularly interesting and contains a summary of Mr. Hinks's original and important contributions to the discussion of the choice of a Figure of the Earth. The writer of this notice would like to suggest that Mr. Hinks should write that much-desired modern English text-book of Geodesy. Clarke's book is now more than fifty years old, and was never really a text-book in the ordinary sense of the word. A text-book of the same size and general character as the book under review would be a real boon to all engaged in the higher branches of surveying; though we cannot add that it would be a very paying proposition. There is a story, perhaps apocryphal, that Clarke received about twelve shillings as the financial reward of his labours in writing his 'Geodesy'!

As regards the contents of 'Maps and Survey,' the first chapter in the new edition is entirely new, and gives an excellent, though brief, history of early maps, with a description of some of them in a select list. Of course in so small a space it was only possible to indicate briefly the main outlines of this branch of the subject; the space allotted to early maps of the British Isles is, for example, less than a page; but this may serve to whet the reader's appetite.

The second chapter, on The Modern Map, is generally similar to the treatment of the same matter in the second edition, brought up to date. No specimens are printed. The author states that he has "judged it no longer possible to give any idea of the range of modern maps from a few small specimens." Also there is the question of the expense of printing coloured specimens. The fifty pages of discussion of The Modern Map appear to be sound and likely to meet with general acceptance. Included in this chapter is a section on the new Ordnance Survey alphabets. The reviewer, personally, likes the new alphabets, but it must be admitted that there are those who do not. We have now got into the region of art, and there is no accounting for tastes.

The analysis of British Official Maps contains a certain amount of controversial matter. Here again we enter somewhat into the region of art. The Popular Edition of the One-inch map of Great Britain was produced after the War, under some pressure, and no one knows better than the writer of this review that it would have been a pleasant thing to have been able to have produced the principal national small-scale maps in the style of, say, the Killarney sheet, or of the Torquay and Dartmouth sheet, or others of that general type, as had been intended before the War. But the War upset this scheme and many others. The Popular Edition served its purpose and sold well, and a high authority has stated that about a third of those who use the Ordnance One-inch prefer the Popular Edition to the new Relief Edition. But the reviewer, on the whole, prefers the Relief Edition, though the minor roads are sometimes difficult to follow, especially in a bad light.

In the excellent chapter on Exploratory Survey Mr. Hinks points out a small error in the formulae upon which Loomis's Tables for the calculation of heights by barometer are based. It is not many of us who would have been thorough enough to examine the original sources of these old tables, which have been used for so many years all over the world. The error is of small importance, but it is an error. Writers of text-books take note. As to the boiling-point thermometer,

the curious thing about this method is that more often than not it gives results which are too high. In the case of Lake Tanganyika the mean result from the observations of eight explorers was 170 feet higher than the present value from levelling. Query, in this case was it the effect of using the slightly brackish water of the Lake?

After a sound account of Trigonometrical Survey, with special reference to topographical needs, we have short accounts of Property Surveys, Geodetic Survey (already mentioned), Photographic Surveying, and a description of certain Survey Instruments, including the prismatic astrolabe, and a brief account of the complicated machinery of mechanical plotters, for use in making maps from air photographs. We may sum up by saying that this is a book which all who are studying maps and their construction should make haste to possess.

C. F. C.

ECONOMIC AND HISTORICAL GEOGRAPHY

THE MAKING OF GEOGRAPHY. By R. E. DICKINSON and O. J. R. HOWARTH. *Oxford: Clarendon Press* 1933. $8 \times 5^{1}_{2}$ *inches; 264 pages; illustrations and maps. 3s 6d*

The continued popularity and usefulness of the brief 'History of Geography' written by the late Sir J. Scott Keltie and Mr. Howarth have induced the second author to attempt a more comprehensive work on similar lines, with the collaboration of Mr. Dickinson. The rather awkward date of 1500 was chosen to divide the periods discussed by the two authors, and Mr. Dickinson allots over two-thirds of his space to a consideration of the development of the subject since 1800. These chapters might well have been expanded and made the theme of the whole book, for there is at present no adequate discussion in English of the Content of Geography. As the book stands, the treatment of the Renaissance Period is necessarily summary and slight, while in the chapters on classical and mediaeval geography no space has been found for the results of recent research. Discontinuity of treatment is a real defect in a work the theme of which is the development of a science. To dismiss, for example, the 'Historia Naturalis' of Pliny in three lines as "poor stuff," while it may be justifiable from the standpoint of classical geography, is to miss an important clue to the ideas current in the Great Age of Discovery, when Pliny ranked high as an authority on the distribution of land and water. Nor can the views of Columbus be understood unless those held by classical writers on the dimensions of the Earth are correctly interpreted. Ptolemy's degree of 500 stadia cannot usefully be equated to 50 miles (p. 34), nor have "geographical miles" meaning in this connection. When Ptolemy's maps were recovered in the fifteenth century, his stadia were reckoned at 8 or 8^{1}_{3} to a Roman, or more often to an undefined, mile. The reader will be further misled by the apparent ascription (p. 59) to Roger Bacon of the measure of 56^{2}_{3} miles to a degree generally associated with Al Ferghani, nor are there any bibliographical entries to guide him to fuller sources of information on this difficult topic. M. Burin's translation of the indispensable 'Imago Mundi' is not discussed, nor are the two new editions of Ptolemy, or M. Bensaude's important researches into the Portuguese contributions to geographical science. More surprising still, there is no mention of Nordenskjold's 'Periplus' and 'Facsimile Atlas,' which surely no student of the 'Making of Geography' can afford to neglect.

In Mr. Dickinson's chapters bibliographical references are more numerous, although they are given with a regrettable lack of scholarly care, and often in such a way as to be of little use to the student. This author's absence in America

while the book was in the press helps to explain the numerous inaccuracies of which the following are examples: "Pierre" Bienewitz, "Jean" Schoner, "Jean" Werner, "William" Snell, "Charles" Huygens, "Rumbold" Mercator. Errors of fact are sometimes serious: Harrison's chronometer, which solved the longitude problem, was not a "pendulum clock" (p. 111); there is no prime meridian on Juan de la Cosa's portulan chart (p. 109); the method of calculating longitude by the declination did not break down "owing to the annual magnetic variation" (p. 109); Vespucci did not discover "the island of Georgia" in 34° (p. 76); when Columbus spoke of the movement of the sky he did not mean the wind (p. 99). Regiomontanus was not the first to publish Ephemerides, nor was Christopher Saxton's Atlas "followed by Timothy Ponts's (*sic*) maps of Scotland, 1608." Jean Fernel would have had some difficulty in obtaining "a remarkably accurate measurement of the length of the degree" by merely "counting the revolution of a carriage wheel between Paris and Amiens," and such statements suggest that the author is hardly equipped to deal with the history of mathematical geography and cartography. A wider experience of Renaissance literature would have taught him to avoid dogmatic statements regarding contemporary thought. The fact, for example, that Cluverius continued to adopt the Ptolemaic system in his text-books is no evidence that "he does not know of the views of Copernicus" (p. 105), for in view of Cluverius's education and personal circle, he must inevitably have both heard and read discussions of the Copernican hypothesis.

It is true however that no writers of a general history can hope to satisfy the specialists upon particular epochs, and when he reaches the nineteenth century Mr. Dickinson handles his material with more assurance. His history of the recent development of Human Geography and of the Regional Concept should prove very useful, even although not all will agree with his conclusions. Regional synthesis is rather a means to a wider end than an end in itself, but the author is correct in saying that it is in the detailed application (should it perhaps be verification?) of general principles that the main future task of the geographer lies.

E. G. R. T.

PROBLEME DER LANDWIRTSCHAFTSGEOGRAPHIE. By LEO WAIBEL. (Wirtschaftsgeographische Abhandlungen. Nr. 1.) *Breslau: Ferdinand Hirt* 1933. $9\frac{1}{2} \times 7$ *inches; 94 pages; diagrams and map. M.*4.50

This publication in pamphlet form contains five papers on the economic geography of agricultural industries. In the first the author sets forth considerations as to the methods of investigation in this branch of work which, as he justly maintains, stands "in the forefront of geographical interest." Here he emphasizes the importance of considering not only the natural conditions in relation to the requirements of plants and animals, but also and especially the sum-total of human powers ("der ganze Bereich menschlicher Kräfte") available in each area. Thus agricultural geography has to synthesize natural and social factors, and demands close and intelligent observation in the field on the part of its serious students.

Both the second essay which deals with the economic structure of tropical plantation industries, and the fifth which surveys the supplies of produce furnished by tropical regions to the Temperate Zone, are able and interesting studies. In these the author carries out his own precepts with marked success: both are compact, well ordered and satisfying accounts, models in their kind. The third essay is an analysis of the profound effect of unusual surroundings upon the ways of living and the character of an isolated group of people, the semi-nomad Trek Boers; its main theme is to show how "cultural retrogression" has in almost every way followed upon "the transformation of a hygrophilous

people into a xerophilous people." Some thirty pages are devoted in the remaining essay to an attempt to show the significance for agricultural geography of Von Thünen's conception of concentric zones of exploitation, becoming more and more extensive in form outwards, in the so-called Isolated State. The theory, or law, as Waibel calls it, is ingeniously applied to present-day Europe, where the inner ring of maximum intensification is found to lie round the southern section of the North Sea.

The varied programme in this set of papers stimulates thought, even though the reader may feel at times that the argument is somewhat forced. E. W. S.

A POLITICAL GEOGRAPHY OF THE BRITISH EMPIRE. By C. B. FAWCETT. *London: University of London Press* 1933. 9×5½ *inches;* xiv+410 *pages; diagrams and maps.* 18*s*

Since imperial relations are much discussed at the moment, it is useful to have at hand this work of Professor Fawcett's which is mainly devoted to setting out non-controversial data. The questions most pertinent to political geography are strategical position, man-power, natural resources, and the more imponderable factors which may be labelled cultural. Each component part of the Empire—Dominions and Dependencies—is treated from these points of view, in their internal and external relations. It is not strictly accurate to compare the Empire as a whole with other Great Powers, as Professor Fawcett does in his opening lines, though later of course he recognizes the constitutional position. It would be an interesting exercise in political-economic theory to analyse and compare the respective relationships, for example, between the United Kingdom and one of the Dominions or foreign countries such as Denmark and the Argentine, with those existing between, say, France and the Little Entente, where there are political, economic, and, to some extent, cultural bonds, or the United States and the Caribbean countries.

The main themes of this political geography will be familiar to most students of imperial relationships, but certain features are stressed more fully than elsewhere—the distribution of population, the reserves of natural resources, including cultivable land, and the present racial composition of the peoples. The kernel of the Empire is shown to be the English lowland, with a population of nearly thirty-five millions, and the strategic considerations arising from this fact are emphasized—as are the abnormal concentrations of population in Canada and Australia, which bring similar problems in their train.

Other aspects which emerge are the preponderant part taken by India in the Empire outside the Dominions; the extent to which this determines the value of the Suez Canal; the relatively unfavourable position of imperial air-routes as opposed to ocean communications; and the role of the Indian Ocean in imperial geography.

The crux of the problem for the future is the disparity between the present population of the Dominions and their potential capacity. Their total white population is at present about eighteen and a half millions. Professor Fawcett estimates their optimum capacity at a figure approaching 180 millions. To reduce considerably this margin would involve tackling a multitude of social and economic considerations, yet this is plainly necessary, if even more acute problems are to be avoided in the future.

In a final chapter on world relations, he raises the intricate question of the future foreign policy of Britain—though without reaching very definite conclusions. He is whole-heartedly for co-operation with the United States, but recognizes the "dilemma" created by their "uncertain policy." At the same time, he sees that Great Britain cannot break away politically from Europe, the

"danger zone" of world politics. Whether it will be possible for Britain to reconcile her Empire, European, and American policies is perhaps a question outside the scope of political geography.

In the chapter on Canada, more detailed treatment of the conflicting interests of East and West might have been given, especially with regard to the Hudson Bay route and to the St. Lawrence Deep Waterway—the latter a complicated undertaking of international importance.

Professor Fawcett adopts the rather self-conscious term "Englishry" in place of "English-speaking peoples." As a very considerable proportion of the populations are not of English origin, its appropriateness may be doubted. The book is well provided with sketch-maps; many of these are on the transverse Mollweide projection, which shows very clearly the relations of the various Dominions to surrounding land masses.

The price of the book is high, and it is to be hoped that it will soon be available in a cheaper edition to a wider circle of students. G. R. C.

GENERAL

HUNTING WILD BEASTS WITH RIFLE AND CAMERA. By C. T. Stoneham. *London: Thomas Nelson and Sons* [N.D.]. $9\frac{1}{2} \times 6\frac{1}{2}$ *inches;* 220 *pages; illustrations.* 7*s* 6*d*

Of late years the hunter with a rifle has steadily given way to the hunter with a camera. Mr. Stoneham stresses this fact in his interesting and informative book. "In the future," he assures us, "the true sportsman will be the friend and champion of the beasts; he will secure his trophies with the film and shutter, instead of with the rifle and trap, and when he points to the framed picture on his study wall he will feel greater satisfaction than if it were a head, or mask, for he will know that the subject of it is none the worse for its brief contact with a human being." The truth of this prophecy is devoutly to be hoped for, and his book lends a helping hand to its fulfilment. It begins with a chapter of advice to the photographer, telling him something of his difficult art and suggesting many useful tips. Then follow several chapters on the most spectacular of wild beasts. We are taken first to India and told about the tiger, elephant, sloth bear, and panther. Then we go to Africa and are introduced to the rhinoceros, lion, leopard, buffalo, giraffe, and others. Lastly we enter the wilds of Canada, where we meet the moose and the grizzly bear. Much is told about the habits of these animals—a great deal of it first-hand information—which should interest the student and naturalist, while the accounts of hunting adventures would appeal to the sportsman. But the chief thing about the book is its advocacy of the camera and its demonstration of what the camera can achieve. R. W. G. H.

ROLLING STONE: the life and adventures of Arthur Radclyffe Dugmore. By Lowell Thomas. *London: John Long* 1933. $9 \times 5\frac{1}{2}$ *inches;* 256 *pages; illustrations.* 16*s*

This is the story of an eventful life, one of hard struggle and varied adventure, which should interest numerous readers, for Major Dugmore has followed many callings. He is a mariner, a naturalist, an author, a big-game hunter, an explorer, an expert photographer, an artist, and a soldier.

The book begins in Ireland. Major Dugmore's father was a noble but eccentric figure. The whim of the moment was all that mattered to him. He dissipated his small fortune, and, when young Dugmore was twelve years old, purchased a schooner, made it his home, and went off with his family to cruise the oceans.

Dugmore in consequence had little or no schooling, and his aimless existence brought him no satisfaction. He quarrelled with his father and deserted the ship. Then followed a hard struggle for existence. He opened a photographic studio, tried to make a living by painting birds, then got a job to go to Northern Canada in order to study and paint the beaver. In 1908 he visited Africa; then followed trips to Newfoundland, Nova Scotia, Labrador. Everywhere he went he photographed and painted, and on his return to civilization gave lectures and wrote books, and in the end built up a reputation as a student and portrayer of wild life. In this book, with its beautiful illustrations, we can follow him through his many exciting adventures. R. W. G. H.

LITTLE SHIP WANDERINGS. By J. B. KIRKPATRICK. *London: Edward Arnold & Co.* 1933. $7\frac{1}{2} \times 5$ *inches; 254 pages; 7s 6d*

Sailing men and lovers of a good yarn will enjoy Mr. Kirkpatrick's book, and geographers of other categories ought to read it as part of their education. This matter of the narrow and broad seas is one that they often neglect. After all, the Earth's surface is a sheet of water broken by some solid obstructions, and yet text-books and atlases devote most of their attention to one-fifth of that surface and very little to the other four-fifths. The Thames estuary, the Channel, the Bay of Biscay, and the North Atlantic are topics lightly touched upon in most geography books. (Think of the disproportion: the Atlantic is infinitely more important than Ireland in the world's economy, yet Ireland always gets a page to itself in the school atlases, and the Atlantic hardly ever.) Mr. Kirkpatrick conducts us about these areas in various craft and companies, an unseaworthy converted ship's boat owned by an impecunious syndicate, a smart 6-tonner sailed single-handed by himself, and a swift competitor in the Fastnet and Transatlantic races, worked by a tough crew of eight. Each tale contains much sailing lore and a good deal of practical geography. Until some one produces a text-book of this side of geography it can best be picked up by reading such books as the present, unless indeed the student will follow Mr. Kirkpatrick's example by doing some field-work in a boat of his own. The author writes good prose, lucid and unaffected. He presents the interest of the sea in the light of clear statement, not in a fog of "artistic" interpretation. His last chapter, "The Riddle without an Answer," is perhaps the best in the book. J. A. W.

THE MONTHLY RECORD

ISAAC TAYLOR'S MAP OF HAMPSHIRE

Isaac Taylor's Map of Hampshire, 1759, of which an excellent reproduction has lately been published by the Hampshire Field Club and Archaeological Society, is a beautiful example of the map-engraver's art in which prominence is given to elaborate ornamentation. It is finely engraved and the picturesque views of such famous local buildings as Carisbrooke, Porchester, and Calshot Castles, the ruins of Netley Abbey and the Roman remains at Silchester which decorate it make it a very interesting and attractive map. But apart from its artistic qualities it has value from a cartographical point of view; it is on a larger scale and contains greater and more accurate topographical and other detail than any earlier map of the county, thus marking an important stage in the development of the cartography of Hampshire. The map is drawn from Taylor's own surveys on the scale of 1 inch to the mile and is printed in six large sheets, each about 22 by 28 inches. The reproduction, which has been produced by photolithography, is slightly smaller, the scale having been reduced to three-quarters of an inch to the mile, and it is very satisfactory to find how well the clearness of detail has been preserved in the reduction, though here and there some of the smaller names have become obscure by a thickening of the hill-shading. It is however an excellent facsimile and great credit is due to all concerned in its production.

The reproduction was made from the copy of Taylor's map in the Society's collection, but this is not stated either on the map itself or on its cover.

PROGRESS OF THE LAND UTILIZATION SURVEY OF BRITAIN

The Land Utilization Survey of Britain has now been in existence for nearly three years, and has made very great progress since Dr. Stamp, its Director, gave an account of its work and aims in a paper read to the Society in January 1931 (*Geogr. J.*, vol. 78, p. 40). In spite of the difficult period during which the scheme has been at work, it has made excellent progress, as may be seen by the map on p. 72, which shows in black the areas which have been completed and for which the six-inch sheets have been returned to the Central Office.

The map takes no account of work which is in progress at the present time, but which has not yet been completed; even so it bears eloquent testimony to the enthusiasm of the many thousands of volunteers who have carried out the work. In the majority of counties the survey has been organized by the Directors of Education and carried out by the schools, and already forty-six out of ninety-three administrative counties have either completed or practically completed the field work, and only in nine counties is the whole of the ground not yet being covered. The completion of all but a few areas is therefore now in sight, and it is expected that practically all the field work will be finished by the end of this year.

Already some 12,000 completed sheets have been received at the Central Office of the Survey at the London School of Economics, where they are indexed and filed, and the complete set is being kept together as far as possible. In any case photostat copies are being made, so that this unique national record may be available for reference; and all notes made by the surveyors will be preserved in their own handwriting.

There is ample evidence that, in carrying out the field work, a great impetus has been given to the extension in the schools of the country of the study of local geography and the adoption of the methods of Regional Survey. An objective

Map showing (in black) areas in which work has been completed for the Land Utilization Survey of Britain

has been given to map-reading, and to precision of observation and recording, while the realization of the significance of the work has fostered a valuable spirit of co-operation in an important geographical enterprise. The work has not, of course, been confined to schools, for many local societies, Scout and Guide troops, and other organizations and individuals have helped, while most University Geography Departments have given the very greatest assistance in organizing large areas, or in covering gaps. An example of such assistance, and of the enthusiasm which has been displayed for the work, is shown in the recent instances of small groups of students from two of the London Colleges, who have devoted several weeks of their vacation to the completion of all the six-inch sheets required to cover the area of a one-inch map in parts of the country where various difficulties have prevented the schools from undertaking the task.

The most important aspect of the work is the publication of the results in the form of one-inch maps, corresponding to the 4th (Popular) Edition of the Ordnance Survey series, and overprinted in colour on those sheets. The work of editing the sheets, and their reduction in manuscript to the one-inch scale, is carried out at the Central Office, and the coloured maps are then printed by the Ordnance Survey, who have throughout given the greatest assistance. Seven sheets have been published, Nos. 35 (Liverpool and Birkenhead), 58 (Cromer), 87 (Ipswich), 114 (Windsor), 142 (Isle of Wight) of the English series, and Nos. 4 (South Mainland, Shetland Islands) and 68*s*. (Firth of Forth) of the Scottish series. The maps have been issued in two forms, flat and unmounted (price 4*s*.) and mounted on linen and folded in covers (price 5*s*.). Several more sheets are in active preparation, including Nos. 11 (Durham and Sunderland), 12 (Ambleside and Keswick), 67 (Norwich), 72 (Birmingham), 95 (Luton), 115 (S.E. London and Sevenoaks, 146 (Land's End and Lizard) of the English series, and Nos. 53 (Sound of Mull) and 78 (Ayr and Kilmarnock) of the Scottish series. Great interest has been shown in the work by regional planning committees and such bodies as the National Trust and the Council for the Preservation of Rural England. While it is impossible to forecast exactly which maps will be issued in the near future, every effort is being made to bring out as many sheets as possible, particularly sheets representing many different types of landscape.

JOURNEY IN KAFIRISTAN

The second supplement to the *Geographische Wochenschrift* is a monograph on Kafiristan by Dr. Martin Voigt, based upon a journey in eastern and central Kafiristan in 1928. The author was for three years in Afghanistan, so that, though he spent two months only in Kafiristan, he has been able to supplement his information considerably. The previous, and almost the sole, authority for this region is Sir George Robertson, who described his visit in 1890 in his "Kafirs of the Hindu Kush." Dr. Voigt acknowledges his indebtedness to him, while emending his account in various details. He defines Kafiristan as the three valleys of the Bashgul, Pech (or Presun), and Ramgul (Alingar) rivers which flow from the Hindu Kush to the Indus system. His journeys were made in the first two, the last being still almost entirely unexplored by Europeans.

The mountain chains of Kafiristan are stated not to be north-south spurs of the main Hindu Kush range; the severe dislocation of this area and the strong erosion of the rivers have given them a deceptive strike. They are also of older formation. The prolongation of the southern arc of the Hindu Kush to Koh-i-Baba is therefore incorrect. The southern portion of Kafiristan is a high plateau, bordered by the Bashgul and Pech, which is distinct from the surrounding country. Its summits, disposed in an east-west direction, rise to 4700 metres. In contrast to the rest of Afghanistan, Kafiristan has a heavy

rainfall, both in summer from the south-west monsoon, and in winter. The country is in consequence well-wooded. Between 1500 and 2000 metres there is a mixed zone with the evergreen holm-oak predominating, and trees such as the tamarisk, pomegranate and walnut along the streams. This gives place to a coniferous zone (Himalayan cedar) up to 3500 metres, where Alpine meadows begin. It is these woods that give any hope of economic development in the near future.

A great part of the monograph is given to the people and their life. Dr. Voigt reports them as being well behaved, unlike neighbouring tribes. After reviewing previous theories as to their origin, he concludes that they are not an Indo-Aryan, but a European-Aryan fragment of the Indo-Germanic race, which was probably driven to its present inaccessible home by the Huns early in the Christian era. Their settlements, the sites of which are determined solely by considerations of defence, have antique characteristics, and seem long established. Perched on the hill slopes, several hundred feet above the valley bottoms, many are arranged in terraces above each other. He estimates the population at 36,000, the largest centre being Kamdesh with approximately 4000 inhabitants. The population is rather denser in the north, where springs and alluvial soils are more plentiful. Economic organization is simple, bread and products of the cows are the staple food: there are no transport animals or anything approaching roads.

The monograph is accompanied by photographs and a map, based upon the sheet of the Survey of India Million map, with routes and additional names.

SEDIMENTATION ON THE GREAT BAHAMA BANK

The International Expedition of 1930 to the Bahamas made several traverses over the shoals west of Andros Island in order to study the deposition of calcium carbonate in this region, and results of some interest were obtained. They are described by Mr. Maurice Black, a member of the expedition, in the *Geological Magazine* for October 1933. The sea-area west of Andros Island is extremely shallow, the bank being here covered by only about 20 feet of water, but falling with great steepness at its edge to depths of from 2500 to 6000 feet. The area acts as a vast evaporating pan, drawing in water from the ocean with a salinity of little above 36 parts per mille, and concentrating the salts in the centre of the bank where a corresponding figure of 38·7 parts was obtained. As the warm surface waters of the ocean in these regions are almost certainly saturated in respect of calcium carbonate, the concentration brings the carbonate content beyond the saturation point and precipitation becomes possible; and the increased temperature due to the shallowness of the water acts in the same direction by decreasing the solubility of the salts. When the water is quiet super-saturation may occur without immediate precipitation, but any violent disturbance will encourage this, partly by the expulsion of carbon dioxide from the bottom. The deposit so formed is largely composed of small needles of aragonite. Mr. Black attempts an estimate of the annual amount of the deposit on the basis of probable net loss of water by evaporation, and thinks that it may reach 0·166 mm. if constituents like foraminifera, chips of mollusc shells, and some limestone grains are included. This is small in comparison with the rate at which globigerina ooze is believed to be forming in deep parts of the ocean, the reason suggested being the paucity of plankton over the shoals. It is thought that on the whole organic agencies play but a small part in extracting calcium carbonate from the water, but that the abundance of suitable bacteria in the sheltered mangrove swamps on the west coast of Andros here favour precipitation.

"SUGAR-LOAF" PEAKS IN BRAZIL

Besides the remarkable peak which with its height of 390 metres at once attracts the attention of voyagers on approaching the harbour of Rio, Brazil can boast of a number of others, some nameless, in the Archaean ranges of Rio de Janeiro, Espirito Santo, and Minas Geraes. They have been the subject of special study during the past twenty years by Dr. F. W. Friese, of Rio, who discusses their character and mode of formation in the *Zeitschrift für Geomorphologie* for October 1933. Of fifty-two peaks which can be brought into this general category, forty-four occur in a belt of country 50 km. wide along the Atlantic coast, and all consist of gneiss, though the character of this may vary, and a mixture of subsidiary minerals like Apatite, Magnetite, etc., is characteristic of them, as is also the prevalence of faulting to which the presence of extraneous masses of quartz and other rocks may be due. The ground-plan of the most typical examples is elliptical and the major axis of the ellipse is always at right angles to the direction of the prevailing wind, whilst the most pronounced rounding and smoothing of the surface is on the side longest exposed to solar radiation. A marked difference is to be observed between the angles of slope on the windward and lee sides, the latter being nearly always the steeper—in some cases actually undercut. After pointing out that the original formation of the peaks as isolated units appears to be due to a series of faults running from west-south-west to east-south-east, the author discusses in detail the agencies to which their present form appears to be due. Chief among these are the wind and the rain which it brings, solar radiation and frost, and the chemical action of salts and acids. In the greater number of cases, as higher vegetation is absent, the organic acids favouring disintegration are confined to the products of lichen-growth on the rock surface, but the effects of these seem to be considerable. When the wind strikes the base of the peak it is deflected upwards and passes over the summit, rain being produced mainly when it reaches the lee side. To this is ascribed the difference of slope between the two sides, disintegration on the windward side being chiefly in the form of dust or small fragments, while on the other the rain loosens whole blocks (especially if the strata dip towards the centre of the mass) which form a mass of talus at the foot. An attempt is made to estimate the annual amount of rock lost by disintegration, the figures obtained being markedly high. For one peak it is reckoned at about 3 kg. per square metre, or some 600 tons in all.

ECONOMIC CONDITION OF AMAZON BASIN

Interesting opinions upon the present economic and social conditions of certain areas in the Amazon basin are set out by Mr. E. Hanson in the *Geographical Review* for October 1933. The author was carrying out magnetic researches for the Carnegie Institution, and so was able to compare the present state of the areas with the reports of former observers. The first region he studied was around the trail which connects the upper Orinoco with the Rio Guainai, a tributary of the Rio Negro. On the upper Orinoco, exploitation of rubber and balata has practically ceased, two white men only remaining to collect balata. The Venezuelan Government had built a road around the Maipure rapids, but the cost of hiring the one available motor-truck almost equals the former cost of portage. San Fernando de Atabapo in the time of Humboldt had 200 Indian inhabitants: about 1913 it was a "white man's" town of 1000 inhabitants: to-day, there are perhaps 20 whites and 40 Indians. On the remainder of the trail there are six abandoned village sites. The final portage from Yavita to Pimichin is probably now more difficult than at any

time since the Spanish conquest. Maroa, on the Rio Guainai, a large Indian town with a white administrator, shows fewer signs of abandonment, for the Indians, freed from the fear of rubber exploiters, are returning to their homes. Mr. Hanson does not believe in the theory that Indians are shiftless and lazy by nature. "If we first rob the Indian of incentive to work we are doing climate a grave injustice by blaming on it the Indian's apparent laziness." This settlement is now practically self-supporting. Owing to the withdrawal of the white man and his articles of commerce, the Indians are evolving a new native culture. On the upper Rio Negro, there was one permanent white settler only, who was making a living by growing *tonka* beans. The inhabitants of the lower river appeared to suffer much more from malnutrition than those first described, largely from a want of fresh vegetables and from their contempt for agriculture as an Indian occupation. Though many posts and villages have been abandoned, the towns of Saõ Gabriel and Barcellos appear to be growing.

The other region examined is that of the Madeira–Mamoré railway. The railway is now run at a small "profit" by neglecting all capital expenses and depreciation of equipment. At Cachuela Esperanza, an attempt is being made to substitute Brazil nuts for the rubber previously exported. This export depends entirely upon the maintenance of the railway. The founder of the settlement has continued to store rubber—to keep his workers together, and to be prepared for a future rise in price. Riberalta is another town which through the energy of one man is meeting the present depression with optimism.

The author summarizes the general situation thus: white men as a whole are withdrawing from the jungle rivers, though a few are striving to adjust themselves to the changed economy, while the Indians are coming into their own again.

ABSENCE OF COLD OFF-SHORE WATER ON WEST COAST OF AUSTRALIA

In the *Annalen der Hydrographie und Maritimen Meteorologie* (1933, Heft VIII and IX) Gerhard Schott, in an article entitled "Auftriebwasser an den Australischen Westküsten? Ja und Nein!" proceeds to place "90 per cent." of the weight of the answer on the "No." The isotherms of the surface water off the west coast of Australia indicate sensibly normal conditions with little or no upwelling of cold water under the influence of off-shore winds, which is so striking a feature of the corresponding coasts of South Africa and South America. Discussion turns upon the reason for there being no vast accumulation of cold sea-water off Western Australia and on the compatibility of this fact with the prevailing dry climatic conditions. It is pointed out that the trend of the Australian coast permits a warm tropical current from the Timor Sea to wash the north-west coast, raising the temperature and promoting the growth of coral, while farther south the strong westerly winds drive the water on-shore. Hence the effect of the off-shore south-east trade is largely counteracted in comparison with the Atlantic coast of South Africa, where various factors, meteorological and oceanographical, favour the upwelling of cold water. Climatically the improved régime in West Australia is reflected in a much narrower strip of dry coast than occurs in South Africa or South America, and also in the almost complete absence of fog. Moreover notwithstanding the vast extent of arid country in the interior, the driest strip of the Australian coast between Geralton and the 90-mile Beach does not receive less than 10 inches of rain a year. That this strip is as dry as it is, escaping the summer rains to the north and the winter rains to the south, is attributed to the fact that the south-east trade here prevails throughout the year and blows out on to the sea-water which is not sufficiently warm to

disturb the equilibrium tending to drought. For it is argued, correctly as it seems, that if the sea-water off Western Australia were markedly warm, droughty conditions would be impossible, since masses of warm moist air would find frequent opportunities to interact with the land winds and bring rain to the coast. It will be recalled in this connection that when in 1925 warm water of the El Niño current replaced the normal cold water of the Humboldt current torrential rains fell on the desert coast of Peru.

Freedom from fog on the Western Australian coast is definitely associated with the absence of cold water. In South-West Africa and Northern Chile it is a curious paradox that the very factor which enhances the rain-drought of the coast, namely cold water, mitigates it by producing wet fog and mist.

HAWKE'S BAY EARTHQUAKE OF 1931

A full report is issued by the New Zealand Department of Scientific and Industrial Research (*Bull.* no. 43, 1933) on the most destructive earthquake in the history of the Dominion, that which on 3 February 1931 destroyed the towns of Napier and Hastings with the loss of 260 lives.

The Report opens with an account of the wreckage, the outbreak and spread of fires favoured by wind, and the emergency measures taken by the citizens to meet the situation. Life became fairly normal again about the middle of March, and it was fortunate that fine warm weather, permitting people to live comfortably in the open, greatly assisted the efforts made to prevent outbreaks of disease resulting from the fracture of water-supply and sewage pipes. It is emphasized that had the buildings of Napier been better designed for a country liable to earthquakes the loss of life would have been very small, and special legislation for the control of building has since been introduced.

For ten years before the earthquake there were no shocks in the Hawke's Bay district, though slight or moderately strong earthquakes were felt at a short distance inland and also out at sea. The great earthquake occurred without any warning at 10.17 a.m. (N.Z.M.T.) on February 3. Lasting about 2½ minutes, it caused damage in several towns, especially in Napier, Hastings, and Wairoa, in which the numbers of deaths were 161, 93, and 2, respectively. The area of destruction (included within the isoseismal of intensity 9, Rossi-Forel scale) is about 100 miles long and 30 miles wide. The earthquake vibrations were felt with decreasing intensity over most of the northern half of the South Island, but they extended farther south along either coast than the middle of the island. The most distant station which distinctly felt the earthquake was Timaru, some 150 miles south of Christchurch and 460 miles south-west of the epicentre—a similar distance from the origin to that recorded in the case of the Japanese earthquake of 1 September 1923. The seismographic records at three neighbouring observatories show that the first movement occurred in lat. 39° 20′ S., long. 177° 0′ E., a point on the coast-line about 10 miles north of Napier, and at a depth of about 13 miles. The after-shocks were numerous, 151 being recorded at Wellington (175 miles from the epicentre) on February 3, and 461 more by March 3. A list of the 86 principal after-shocks until 28 June 1932 is given, only two of which, on 13 February 1931 and 5 May 1932, reached destructive strength.

The dislocation to which the earthquake was due resulted in the uplift of an earth-block some 60 miles long and 10 miles wide. The Napier district lies between the ocean-floor on the east and the broad Kaweka–Kaimanawa plateau on the west. Pressure from the sea-floor and counter-pressure from the highlands appear to have acted as a couple forcing up the rocks underlying Hawke's Bay. A remarkable uplift of the land was revealed by the rise of the coast near Napier,

by the formation of the ridges in the low-lying Heretaunga Plain to the south-west of Napier, and by two series of levels carried across the plain. These show that, along a line of narrow zone, running south-west from a point about a mile south-west of Napier, there was no change of elevation. To the north-west of this line the crust is raised, at one point by about 8 feet, and to the south-east it is depressed, at one place by from 5 to 19 inches. In the interval of four or five months, between the two series of levels, the upraised mass sank as a whole, the amount of subsidence being greatest (about 1 foot) in the regions of previous maximum uplift. Close to Napier, the coast rose by 6 feet, and, as a result of this elevation, about 5 square miles of the bed of the Ahuriri Lagoon (to the west of Napier) was converted into dry land. At a point on the coast about 20 miles north of Napier, the maximum uplift of 9 feet was measured, to the north of which it rapidly decreased, and beyond the mouth of the Wairoa River, the movements apparently ceased. The total length of the fracture was thus about 40 miles. Repeated soundings carried out in Hawke's Bay showed that, except for the uplift of 6 feet in its southern portion, there was no important distortion of the sea-bed. It is considered that the mountains of New Zealand were forced up during the Pliocene by pressure from the sinking of the floor of the South Pacific Ocean, and that the recent earthquake is an indication that this force is still acting.

CENTRAL HIGHLANDS OF ICELAND

In a handsomely illustrated memoir entitled 'Contributions to the Physiography of Iceland with particular reference to the Highlands west of Vatnajökull,' Niels Nielsen describes an inaccessible and desolate tract, about 1600 sq. kms., which, in company with Pálmi Hannesson, he visited and surveyed in the summer of 1927. [*K. danske Vidensk. Selsk. Skr., Naturvid. og Matthem. Afd.* 9 *Række*, IV. 5 (1933).] This region, lying at an average altitude of 700 metres to the west of the Vatnajökull ice-sheet, to the south of the Hofsjökull, and to the north of Mount Hekla, presents in part a landscape which is a severe wilderness of black lava completely destitute of vegetation, though on fluvio-glacial moraines and in swampy places coarse types occur.

Into the fashioning of the Central Highlands of Iceland an extraordinary complexity of geological and climatic factors has entered. The peculiarities of the relief have been due to tectonic processes affecting the Icelandic region as a whole, but tremendous local volcanic activity has resulted in the formation of a collection of elementary phenomena whose morphological and chronological sequence it is impossible to analyse. During the Pleistocene Ice Age volcanism was very violent, but its traces have been nearly obliterated by recent volcanic activity. Difficulty in correlating the several units is further enhanced by the anomaly that, though the climate is damp, erosion is essentially of the arid type due to wind, and not to water. Hence in the study of the tectonic relations there is none of the assistance rendered in regions of normal humid erosion by watercourses. The aridity of the region is attributed to the extremely porous character of the rocks causing most of the drainage to pass underground, the scant covering of vegetation, and the violent winds of the Icelandic climate which raise large quantities of dust from the friable surface. Moreover, the precipitation does not appear to be heavy in this part of Iceland, and owing to the trend of the highland axis, drying foehn winds are frequent. The result is a desert landscape of the polar type for which the determining climatic factor is the gales, since oases appear wherever the destructive work of the wind is hampered—even close to the ice margin.

The landscape is governed by an annual cycle of denudation in which three

phases occur: winter, spring, and summer. During the long winter phase the ground is deep under snow and little morphological change takes place; during the spring phase there is active solifluction, and the amount of melt-water is so great that temporary rivers and lakes form; during the summer phase aeolic forces prevail: this is the season of violent deflation and corrosion with rapid mechanical disintegration and forming of *hamadas*. Dust-storms occur, but the absence of dunes is attributed to the limitation of this phase to a portion of the year. The region west of Vatnajökull is described as probably the most pronounced example of an Arctic wind-eroded region in the northern hemisphere; but it is emphasized that the determining factor is geological, inasmuch as there would be ample water from rain and snow in Central Iceland to support a continuous covering of vegetation under the prevailing conditions of temperature if it could only remain on the surface.

A second part of the memoir discusses the wider issues of "Iceland's volcanism and tectonics in the light of the Wegener theory." In contrast with the Alps whose tectonics have resulted from pressure, Iceland is a region of tension. Subsidences are the main feature of the structure of Iceland and the land has been split into innumerable fissures.

CORRESPONDENCE

PENEPLAINS OF EAST AFRICA

With regard to Professor Bailey Willis's correlation of East African peneplains (*Geogr. J.*, October 1933, pp. 283–284) I am neither prepared to agree nor definitely to disagree with him at the moment. Pending further studies I prefer to keep an open mind.

Toward the end of 1929, when Bailey Willis visited Uganda after extended travels in Tanganyika and Southern Africa, he, my colleagues, and I spoke of *the* peneplain, and we were agreed that it was of formational importance. We had little thought of a second peneplain in East Africa then, although some puzzling erosion levels were known to us. Later, I found that in Uganda there are two peneplains above the laterite-capped erosion surface which stands well above Lake Victoria and above the swamp (or dry) valleys of the Eastern Province, and elsewhere in this country ("Peneplain III"). Since the publication of my letter to the *Journal* in July of this year (p. 95) the matter has become further complicated, and is at the present time a subject of correspondence between my colleague, Mr. A. D. Combe, and myself.

The position is this: the top peneplain and what we used to call the third are, as a rule, not very difficult to determine, but the so-called second peneplain appears to be not everywhere the same erosion surface. Recent field studies have convinced me, and I understand that Combe agrees, that there are at any rate two other important erosion levels in addition to our three peneplains as originally identified, thus Peneplain III becomes Peneplain V; and it would appear to me, though this remains to be definitely proved or disproved, that the "second" peneplain may be represented by erosion level 2, 3, or 4, since it seems that any one of these may be dominant at the expense of the other two in different districts. The subject calls for further investigation; meanwhile, it will be well to suspend judgment in the matter of correlation of peneplains in widely separated areas.

E. J. WAYLAND

Geological Survey Office, Entebbe, Uganda. 23 November 1933.

MEETINGS: SESSION 1933–1934

Third Evening Meeting, 4 December 1933. The President in the Chair

Elections: Paul Sabel Adler; Syed Ahmad, B.A.; Raymond Richard Baker, B.A.; Miss Glynne Bateson; Oliver Broadgate Brears; H. B. Browne; Sir Thomas Catto, Bart.; Miss Margaret B. A. Churchard, B.A., PH.D.; Gerald Morgan Elias-Morgan; Sqdn.-Leader O. R. Gayford, D.F.C., A.F.C.; Nawab Sir Muhammad Akbar Hydari, LL.D.; Brian Tyrwhitt Wyn Irwin, M.B., CH.B.; Sven Herman Liljestrand, PH.B., M.D.; Stanley George Henry Loosley; George Percival Mason; Lord Meston; Rudolph Henry Petch; The Rev. John Ayscough Rickards; Eric Rudd, B.SC.; Amar Sen; Stanley George Singleton; Miss Hilda H. Spalding; Mrs. Constance Evelyn Storey; Miss Mary Stuart Todd; Eric Montague Turner; Howard Jesse White; Lieut.-Col. Sir Murrough John Wilson, K.B.E.

Paper: The Somali Coast. By Captain R. B. W. G. Andrew

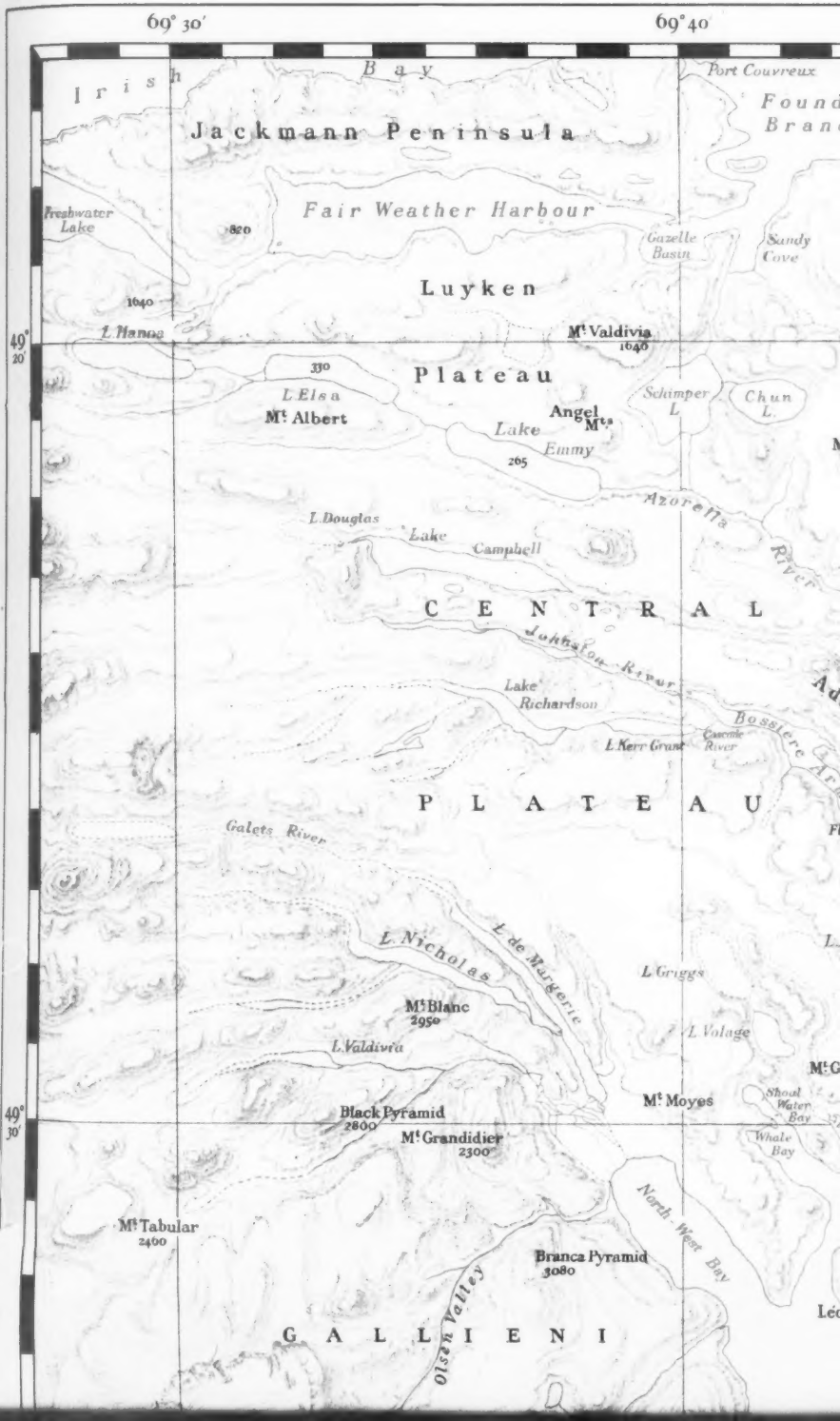
Second Afternoon Meeting, 11 December 1933. The President in the Chair

Paper: Plotting the Vertical Photographs from the Mount Everest Flight. By Lieut. J. S. A. Salt, R.E.

Fourth Evening Meeting, 18 December 1933. The President in the Chair

Elections: Major Oliver Philip Beeman; Miss Else Evensen Blytt; Miss Beatrice Edith Brown; Miss Mary Carter; R. V. A. Corbett; George Edward Raven Deacon; Geoffrey Chambers Flower; Miss S. E. Rani Ghosh, M.A., B.T.; William Thomas Harrison; Miss Lorna Margaret Berthon Howell, M.A.; Miss Yvonne Zoe Huth; Lady Leveson; Henry Trevor Lloyd, B.SC.; R. V. McVittie, M.A.; Charles Alfred Marsh, M.D.; Major David Bannerman Burt-Marshall, D.S.O., O.B.E.; Miss Muriel E. Martin; Lieut. Vincent Oswald Woodfield Peters, R.N.R.; Patrick Stanley Sandilands; The Rev. Arthur F. Smethurst, B.SC., A.R.C.S., F.G.S.; Mrs. Marjorie Sotherby; R. B. Thompson, B.A.; Anthony Harold Williams; W. Dennis Wivell

Paper: The Tugtilit (Lake Fjord) Country, East Greenland. By J. R. Rymill


69° 30′
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Bay
Port Couvreux
Found
Bran
Jackmann Peninsula
Fair Weather Harbour
Freshwater Lake
820
Gazelle Basin
Sandy Cove
Luyken
1040
L. Hanna
49° 20′
Mt Valdivia
1646
330
Plateau
L Elsa
Mt Albert
Angel
Mts
Schimper L.
Chun L.
Lake Emmy
265
Azorella River
L Douglas
Lake Campbell
CENTRAL
Johnston River
Lake Richardson
L Kerr Grant
Cascade River
Bossiere
PLATEAU
Galets River
L Nicholas
L de Marguerie
L Griggs
Mt Blanc
2950
L Valdivia
L Volage
Mt Moyes
Shoal Water Bay
Whale Bay
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Black Pyramid
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Mt Grandidier
2300
North West Bay
Mt Tabular
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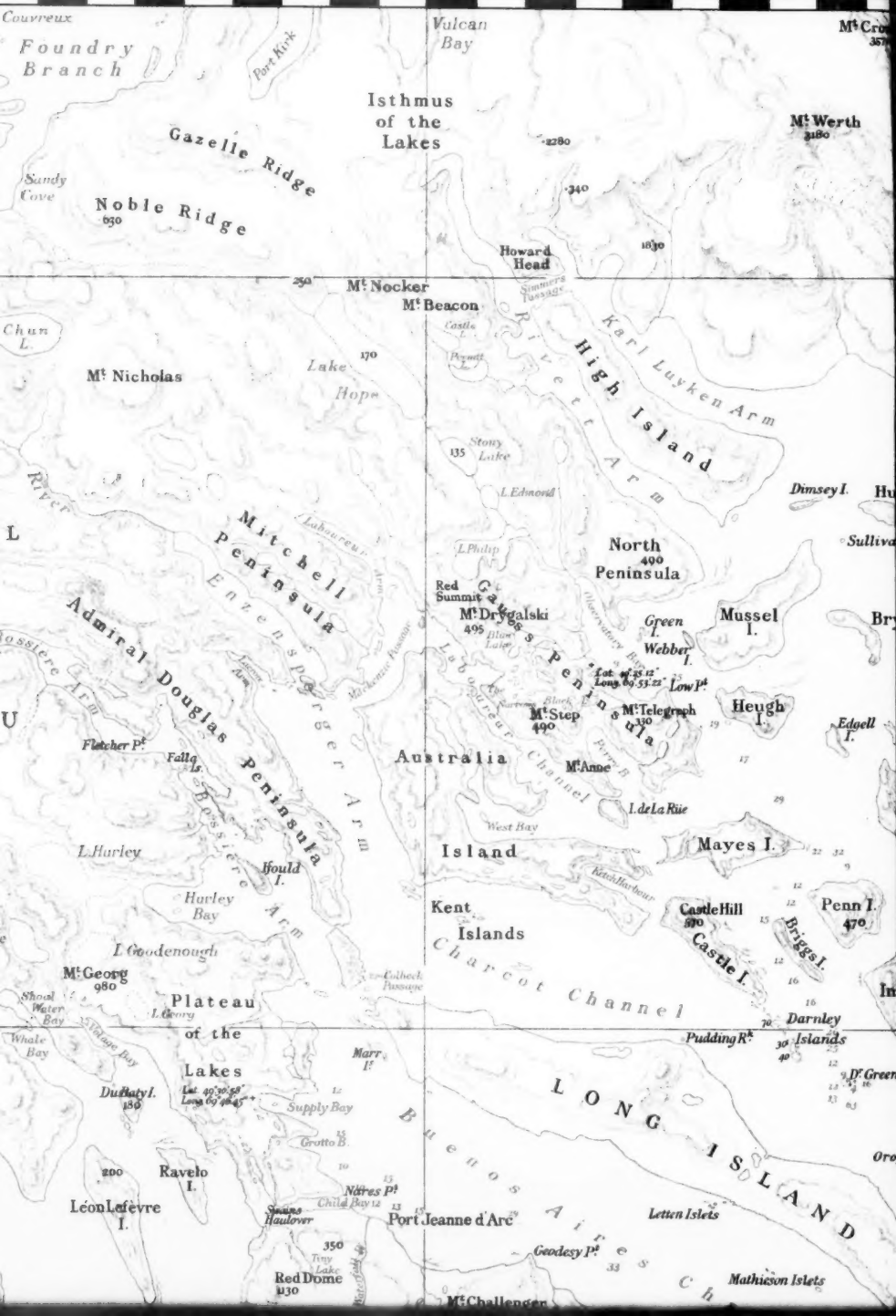
Branca Pyramid
3080
Olsen Valley
GALLIENI


Couvreux
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Port Kirk
Vulcan Bay
Mt Crow
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Isthmus of the Lakes
Gazelle Ridge
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Mt Werth
3180
Sandy Cove
Noble Ridge
650
340
Howard Head
1830
250
Mt Nocker
Mt Beacon
Summers Passage
Chun L.
Castle I.
Pyramid I.
Karl Luyken Arm
Mt Nicholas
170
Lake Hope
Forrester Arm
High Island
Stony Lake
135
L. Edmond
Dimsey I.
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River
L
Laboureur Arm
L. Philip
North 400 Peninsula
Sullivan
Mitchell Peninsula
Enzensperger Arm
Red Summit
Mt Drygalski
495
Observatory Bay
Green I.
Webber I.
Mussel I.
Bry
Admiral Douglas Peninsula
Lat. 66° 55′ 12″
Long. 60° 53′ 22″
Low Pt
Mt Step
490
Mt Telegraph
330
Heugh I.
Edgell I.
Fletcher Pt
Australia
Mt Anne
I. de La Rue
Island
Mayes I.
L. Hurley
Ifould I.
Hurley Bay
West Bay
Kent Islands
Castle Hill
870
Penn I.
470
Briggs I.
Castle I.
L. Goodenough
Mt Georg
980
Shoal Water Bay
Plateau of the Lakes
Colbeck Passage
Charcot Channel
Darnley Islands
Pudding Rk
Whale Bay
Telegraph Bay
Marr I.
Dr Green
Du Hamy I.
150
Lat. 67° 46′ 45″
Supply Bay
Buenos Aires
LONG ISLAND
Grotto B.
200
Ravelo I.
Nares Pt
Child Bay
Léon Lefèvre I.
Swans Haulover
Port Jeanne d'Arc
Letten Islets
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Tiny Lake
Geodesy Pt
Red Dome
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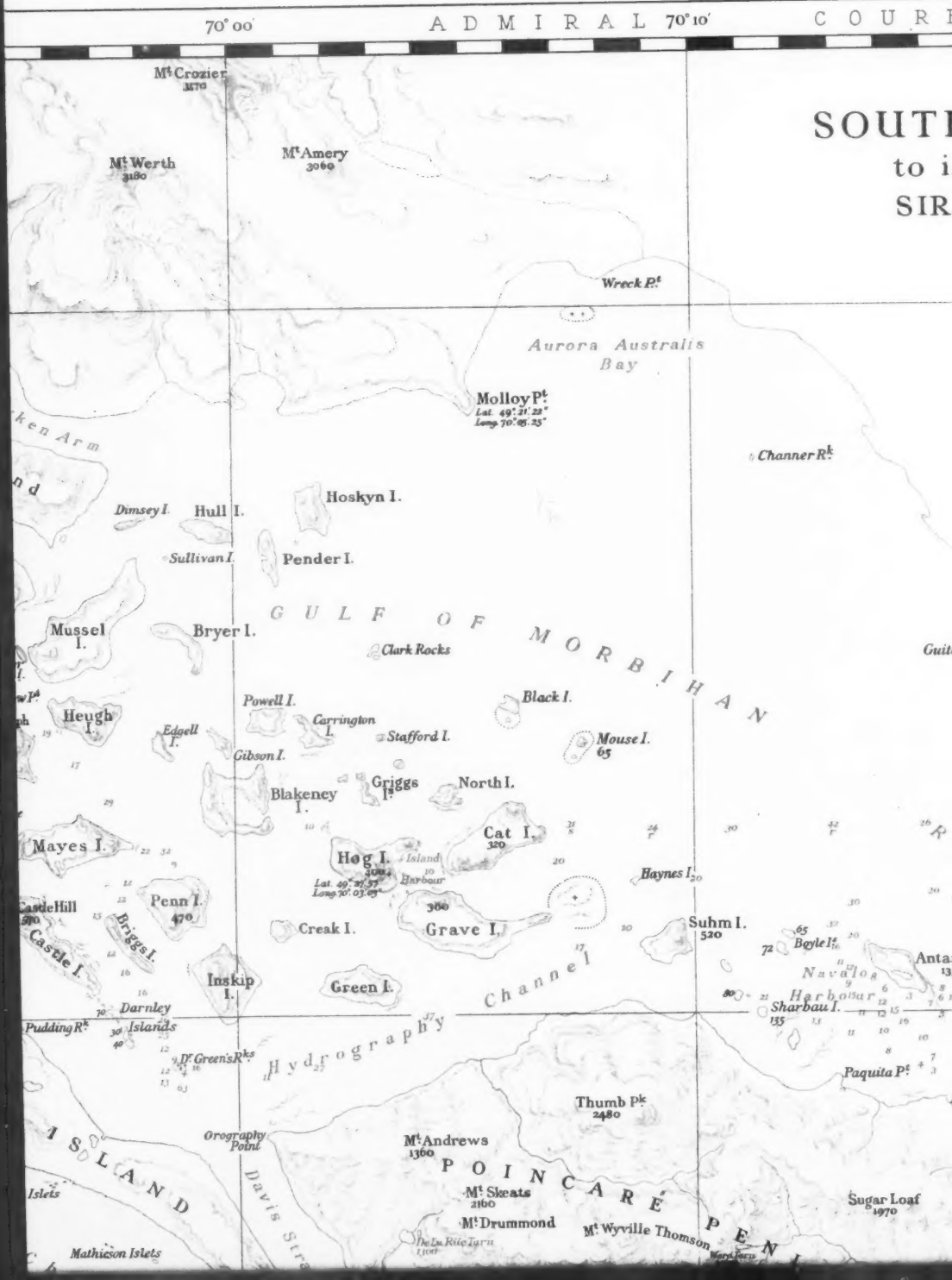
Mathieson Islets
Mt Challenger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Dimsey I.
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Sullivan I.
Pender I.
GULF OF MORBIHAN
Mussel I.
Bryer I.
Clark Rocks
Powell I.
Black I.
Heugh I.
Edgell I.
Carrington I.
Stafford I.
Mouse I.
65
Gibson I.
Griggs I.
North I.
Blakeney I.
Cat I.
320
Mayes I.
Hog I.
Island
Harbour
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Long 70° 03' 09"
Haynes I.
Castle Hill
570
Penn I.
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Briggs I.
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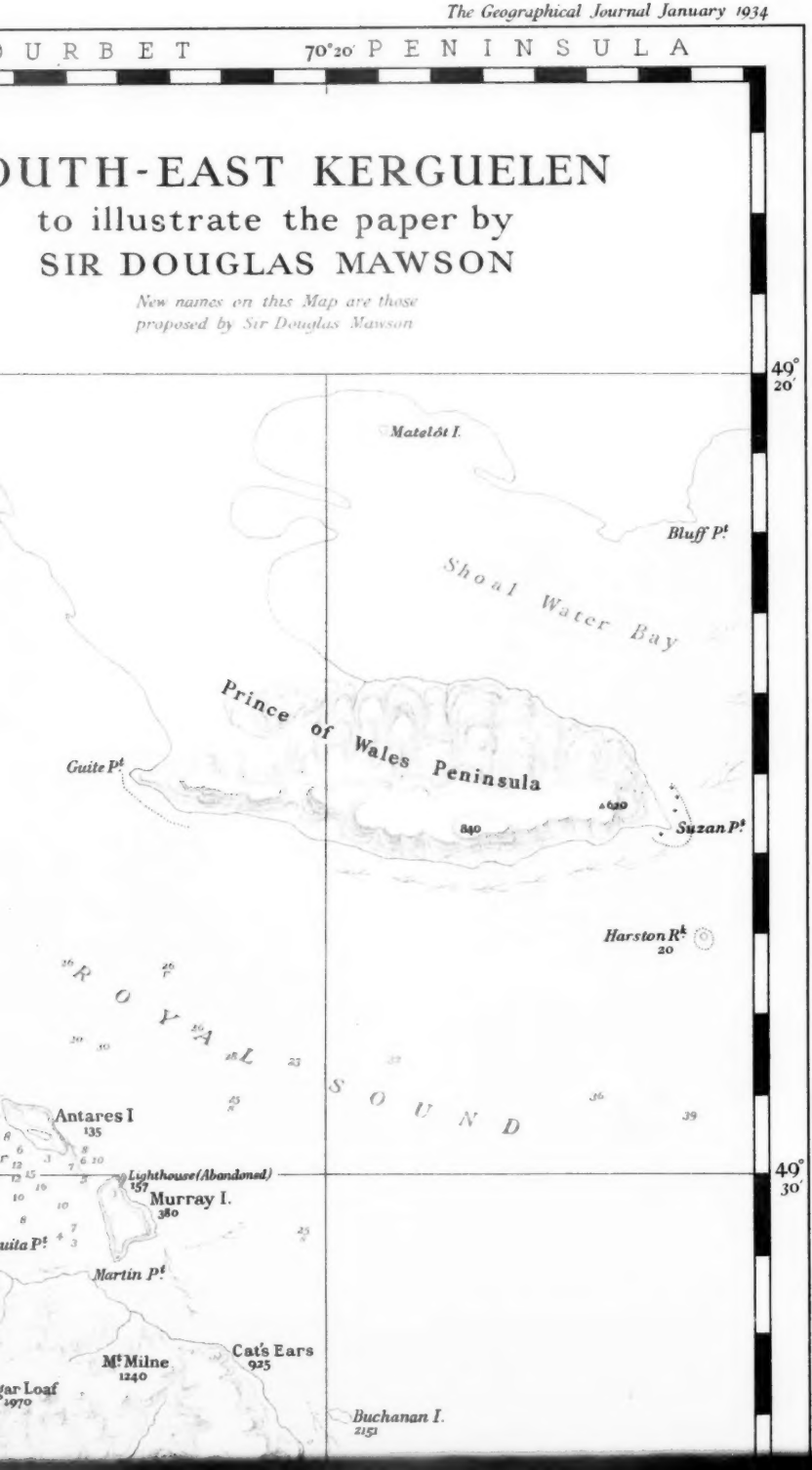
Creak I.
360
Grave I.
Suhm I.
520
Boyle I.
Channel
Inskip I.
Green I.
Darnley Islands
Pudding Rk
Df Green's Rks
Hydrography
Sharbau I.
135
Paquita Pt
Thumb Pk
2480
Orography Point
Mt Andrews
1360
POINCARÉ PEN
ISLAND
Islets
Davis Str
Mt Skeats
2160
Mt Drummond
Mt Wyville Thomson
Sugar Loaf
1970
Mathison Islets


U R B E T
70°20' P E N I N S U L A
UTH-EAST KERGUELEN
to illustrate the paper by
SIR DOUGLAS MAWSON
New names on this Map are those proposed by Sir Douglas Mawson
49° 20'
Matelót I.
Bluff Pt
Shoal Water Bay
Prince of Wales Peninsula
Guite Pt
840
Suzan Pt
Harston Rk
20
ROYAL SOUND
Antares I
135
Lighthouse (Abandoned)
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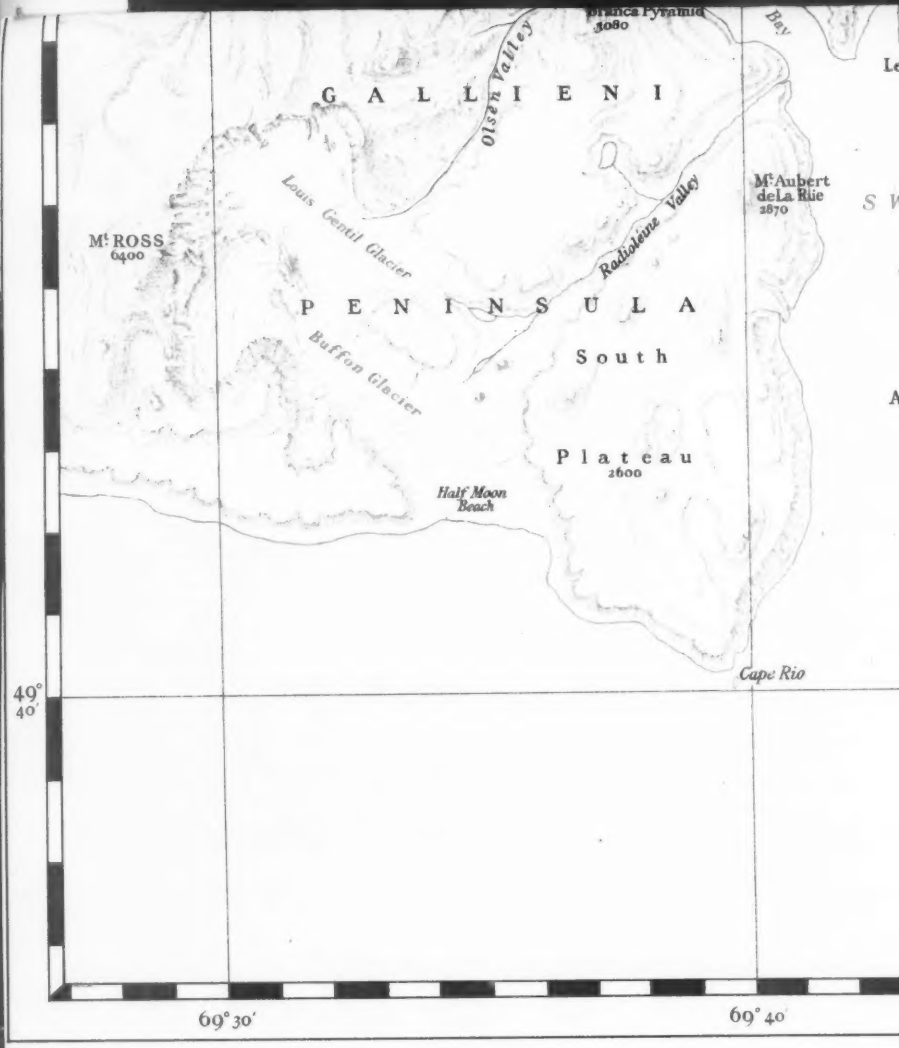
Murray I.
380
Martin Pt
Mt Milne
1240
Cat's Ears
925
Buchanan I.
2151
49° 30'


Prince Pyramid
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Mt Aubert
de La Rue
2870
Mt ROSS
6400
Louis Gentil Glacier
Radioleine Valley
PENINSULA
South
Buffon Glacier
Plateau
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Half Moon
Beach
Cape Rio
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40'
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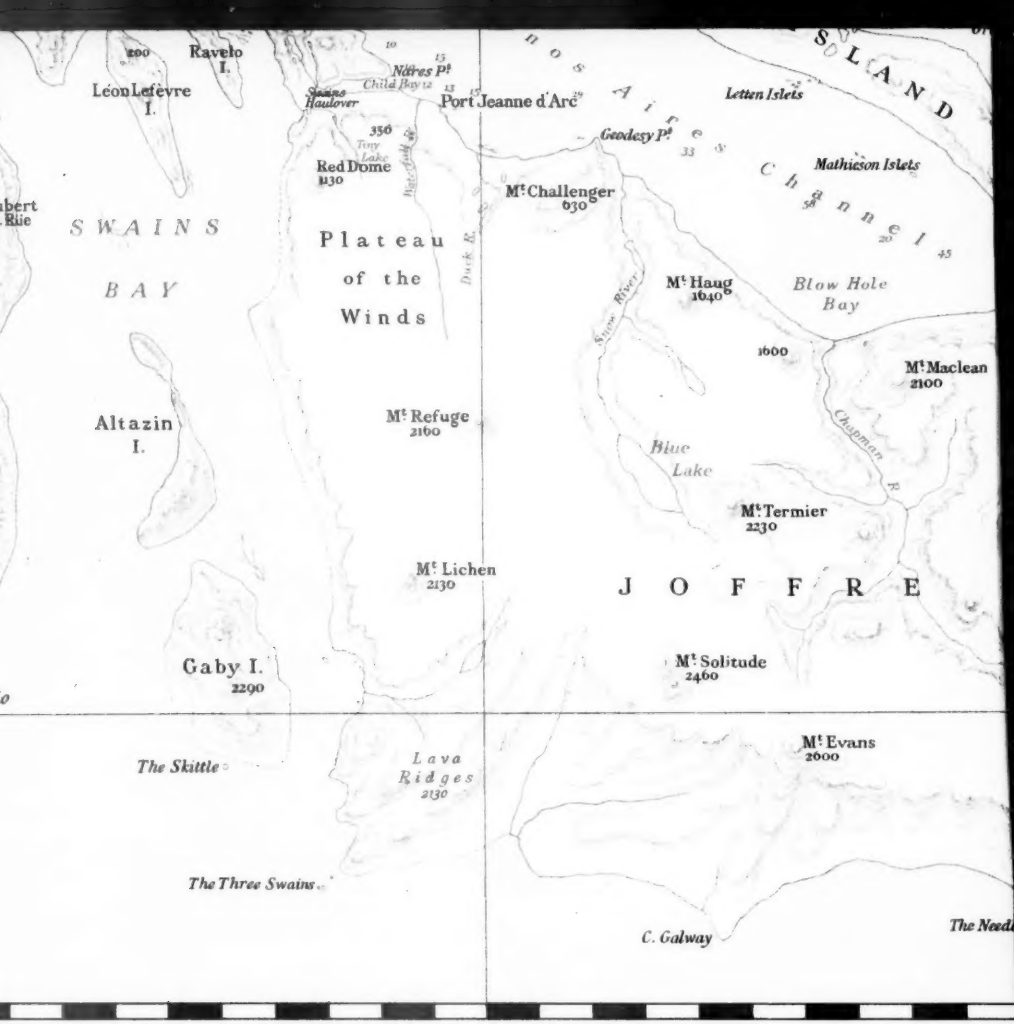

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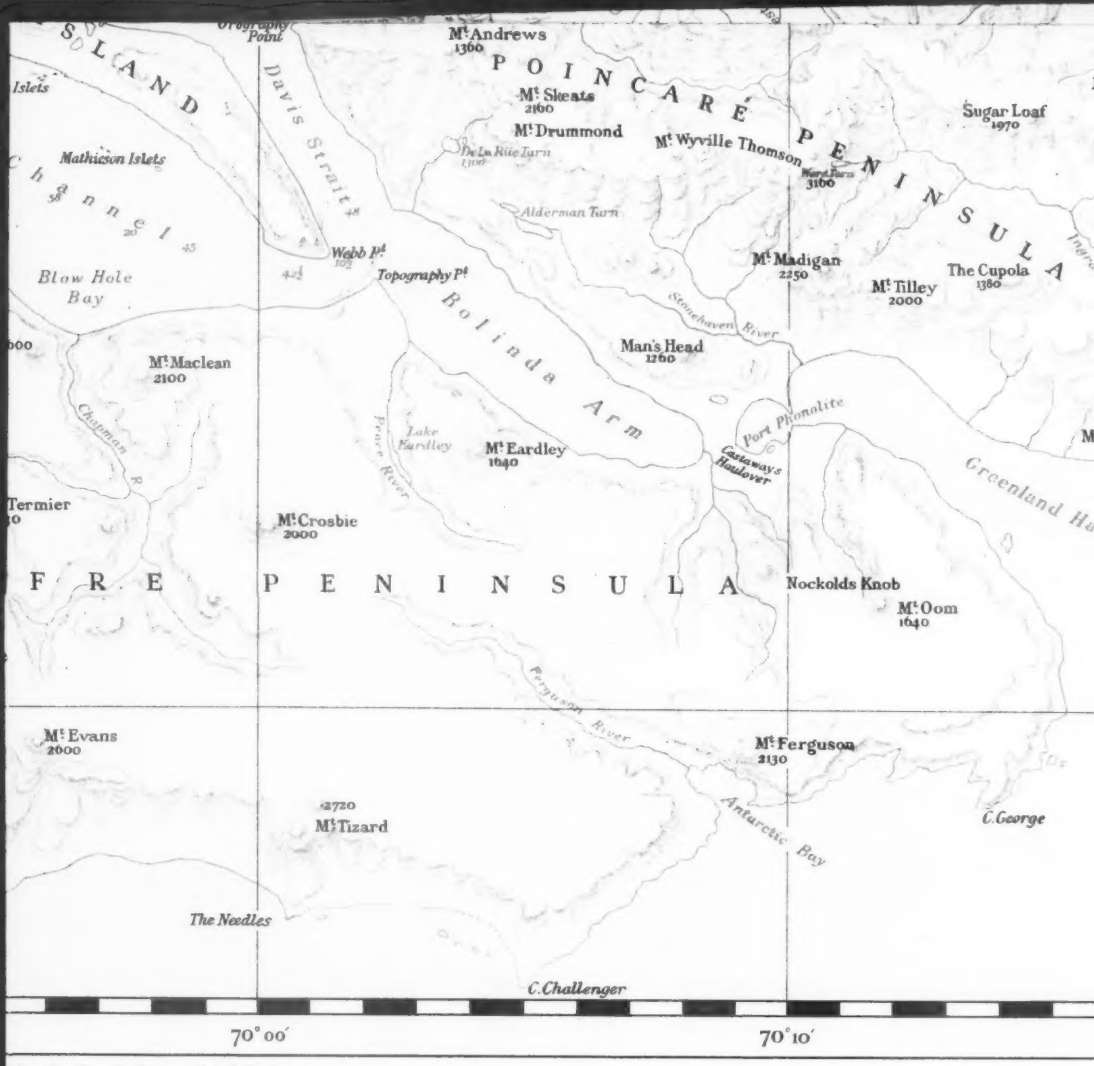

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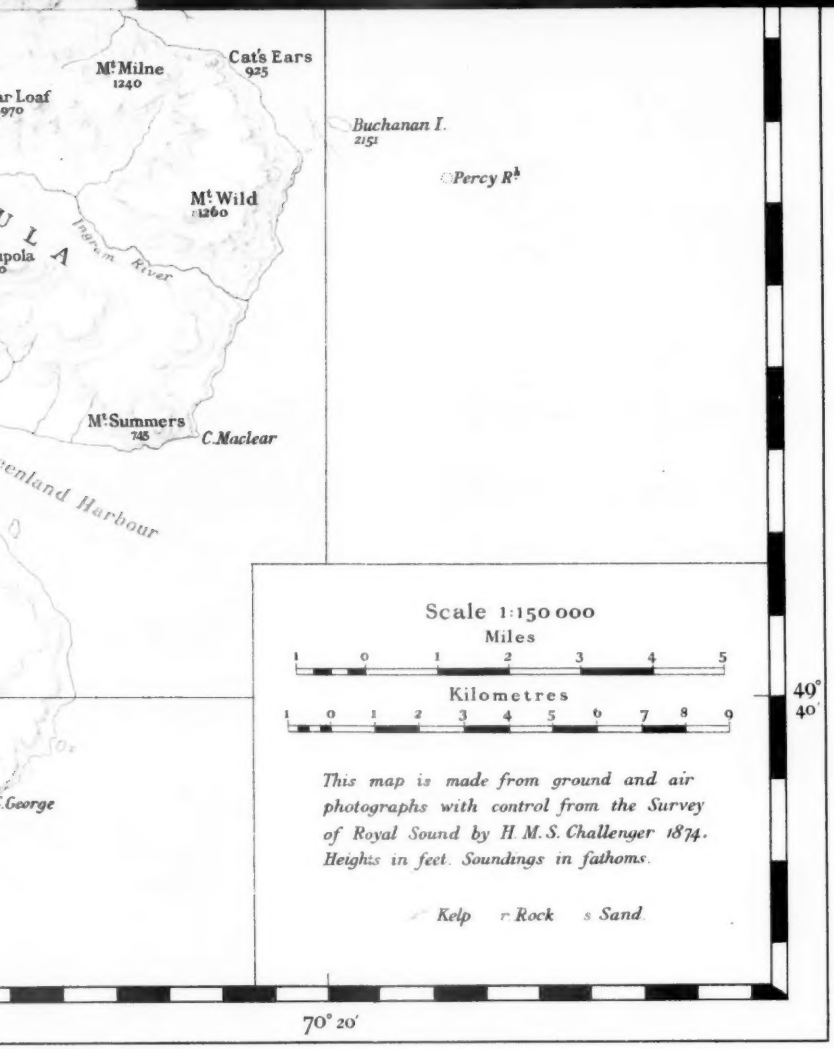

S. E. KERGUELEN

Mawson